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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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No. 1

Bone Lesions in Acquired Syphilis¹

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THE STATEMENT that syphilis is a great "imitator" finds no exception in its bone lesions. Roentgenograms of bones with syphilitic involvement are by no means always characteristic, as they may simulate chronic non-specific osteomyelitis, primary bone tumor, metastatic cancer, multiple myeloma, or any other type of bone lesion.

The abundant blood supply to the bone marrow and periosteum tends to make these structures a good reservoir of infection. The causative organism is borne through the blood stream to all parts of the body. The disease is thus propagated *via* the blood stream, and the invasion of the periosteum or bone is to be expected. If we accept the hypothesis, which appears to be true, that the entire process, as far as bone involvement is concerned, represents an osteomyelitis, it is possible to understand the varying roentgen manifestations. The end-results may be necrosis, sclerosis, osteoporosis, sequestrum formation, or spontaneous fracture. Any combination of these findings may be present so that a multiformity of pathologic processes may appear on the roentgenogram.

The only difference, pathologically, between a gumma and syphilitic osteomyelitis is that in the gumma there are necrosis and occasionally giant cells. There is

perivascular lymphocytic infiltration in both. We feel, therefore, that syphilitic osteomyelitis represents the general classification and that the gumma is merely a type of syphilitic osteomyelitis in which necrosis is the outstanding finding. This view is generally accepted by pathologists, but among some medical groups, including the radiologists, there is apparently no clear conception of the underlying pathological process. Ware (9), Stokes (7), and others (2, 6, 8, 10) state that they consider all syphilitic bone involvement to be the same process with different manifestations. Newman and Saunders (5) describe a case with destruction of bone from secondary syphilis. They state that their patient had a marked toxemia with high fever. Mandelbaum and Saperstein (4) report a case of acute syphilitic osteomyelitis of the skull and sternum following a transfusion in which the donor was syphilitic. A case of syphilitic osteomyelitis with a destructive process in the left humerus is reported from the clinic of Dr. Charles Murray Gratz (3), while Ashhurst (1) describes a case of syphilitic dactylitis in a man forty years of age.

The variable manifestations of syphilitic osteomyelitis make a definite roentgenologic diagnosis very difficult at times. In order to illustrate the osteomyelitic nature of acquired bone syphilis and to demonstrate the multiform and confusing roentgen findings, 9 cases are reported.

¹ From the Radiology Department of the James M. Jackson Memorial Hospital, Miami, Fla. Accepted for publication in August 1942.

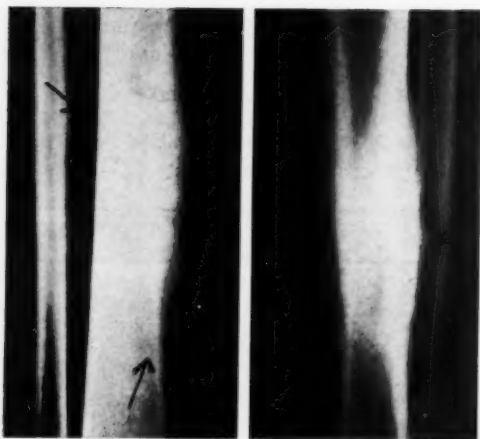


Fig. 1. Case 2: Roentgenograms of the left tibia and fibula showing a bone lesion with periosteal reaction and a suggestion of transverse spiculation. A roentgenologic diagnosis of probable osteogenic sarcoma was made. Biopsy revealed a gumma.

A keen evaluation of the various factors would have led to the correct diagnosis. The suggestion of transverse spiculation is seen to be due merely to an irregular laying down of periosteum and not true spicules.

CASE REPORTS

CASE 1: C. M., a colored male, 20 years of age, was first seen complaining of a very painful "shin" bone. He stated that he had hurt it one year before and that it had been painful ever since. Recently the pain had grown worse and the area had become swollen. Examination revealed a swelling of the anterior aspect of the middle third of the tibia. It was tender to palpation.

The laboratory findings were as follows: Kahn test +; hemoglobin 81 per cent; white cell count 6,300.

Roentgen examination revealed a proliferation of the periosteum and thickening of the cortex, giving the textbook picture of syphilitic periostitis. A biopsy was not done. The patient was put on antisyphilitic therapy and all symptoms disappeared.

Comment: This case is included as a syphilitic osteomyelitis, although actually it was the periosteum which was involved. There is very probably a low-grade osteitis present as well.

CASE 2: L. R., a white female, age 56, was first seen with pain and swelling of the left leg. Two years previous to admission the patient had injured her leg on a rock and it had been painful for several weeks. About one year before admission she noticed a slight swelling. Pain developed in the area six months later, becoming quite severe, and was present at rest but more pronounced upon walking. The swelling had likewise increased.

Physical examination revealed a hard indurated mass on the anterior aspect of the left tibia. The swelling was fixed to the bone and measured $3 \times 2 \times 2$ cm. Palpation elicited severe pain.

The laboratory findings were: Kahn test 4+; white blood cells 11,100. Biopsy was done and a gumma was found.

A roentgenogram of the left tibia and fibula (Fig. 1) reveals a bone lesion with periosteal proliferation and a suggestion of transverse spiculation. There is also evidence of some bone destruction.



Fig. 2. Case 3: Roentgenogram of the right shoulder exhibiting a destructive area on the lateral aspect of the proximal portion of the right humerus with some fragmentation of bone. In addition, there is a pathological fracture. There is no evidence of periosteal reaction. A roentgenologic diagnosis of benign bone tumor was made. The biopsy revealed syphilitic osteomyelitis.

In retrospect, we believe that the findings in the roentgenogram are not typical of a bone tumor of any type and that if more attention had been given to the fragmentation, a diagnosis of probable syphilitic osteomyelitis could have been made before biopsy was done.

Comment: A diagnosis of probable osteogenic sarcoma was made in this case. Proper evaluation of the roentgen findings would have made a diagnosis of syphilitic osteomyelitis possible. What was suspected to be transverse spicules was merely an irregularity in the periosteal proliferation.

CASE 3: A. G., a colored female, age 24, fell and injured her right shoulder the day before admission.

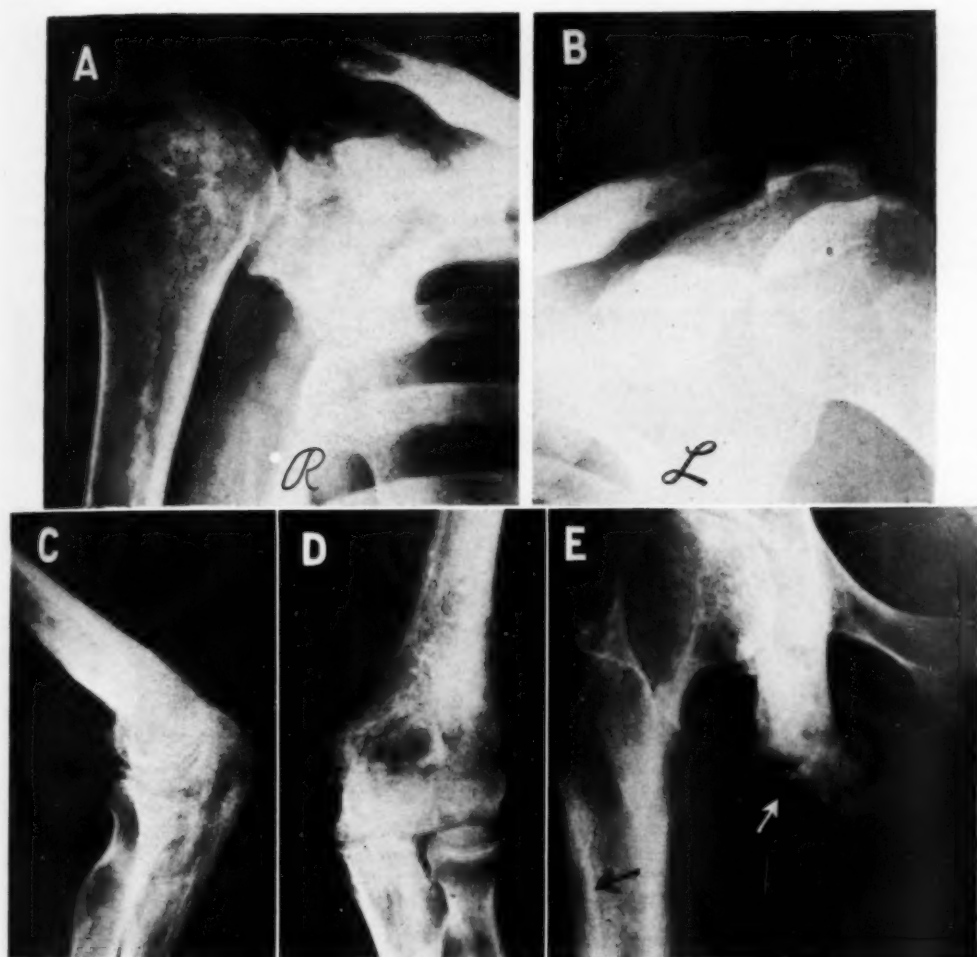


Fig. 3. Case 4: The roentgenograms A and B reveal a marked destructive process involving the lateral aspect of the right clavicle, lateral aspect of the left clavicle, and the right scapula. The medial aspect of the right clavicle is involved as well. The right shoulder region (A) shows a severe osteolytic process involving the clavicle, humerus, and scapula. There is very little evidence of periosteal proliferation but marked calcification is present in the soft tissues. Note the punched-out areas in the right humerus. The ribs are essentially normal. The right elbow region (C and D) shows destruction with also some periosteal proliferation.

The roentgenogram showing the right ischium, right hip joint, and upper right femur (E) reveals a destructive process in the ischium with some evidence of bone sclerosis. The upper end of the femur along its lateral margin also shows some destruction with a slight amount of periosteal proliferation. These changes are much the same as those in the other bones.

This case exhibited such an unusual roentgenologic appearance that a diagnosis of metastatic cancer was made. In retrospect the lesions, especially those in the right acromio-clavicular region, should help to rule out the diagnosis of metastatic growth, as the process extends into the soft tissues with a marked calcium deposit, which is very unusual, if indeed it is ever present, in metastatic bone lesions. Thus, if all of the factors had been considered and evaluated, we believe that a diagnosis of an extensive syphilitic osteomyelitis might have been more strongly considered or even definitely made.

There was no history of any previous trouble with the shoulder. The patient had four children living and well. Physical examination demonstrated crepitus, limitation of motion, and tenderness over the head of the right humerus.

The laboratory findings were: Kahn test 4+;

hemoglobin 56 per cent; white cell count 6,050. Biopsy revealed syphilitic osteomyelitis.

A roentgenogram of the right humerus (Fig. 2) reveals a pathological fracture associated with a destructive lesion involving the cortex on the lateral aspect. In addition there are numerous small frag-

ments of bone lying within the area of destruction. Conclusions: Benign lesion of the proximal end of the right humerus associated with a pathological fracture. The lesion probably represents an osteochondroma. At the time of the biopsy, in view of the x-ray report of a benign tumor with pathological fracture, the lesion was curetted and bone chips were put into the cavity. After a positive Kahn reaction and a biopsy report of syphilitic osteomyelitis the patient was put on antisyphilitic therapy.

tion of motion. Only the joints of the hands and feet were not involved. The patient was totally incapacitated and was bedridden. When admitted to the hospital she was considered moribund and placed on the critical list. She was poorly developed, malnourished, dehydrated and in a semicomatose condition. Her temperature was normal. There was slight deformity of the right knee and of both shoulder joints, with limitation of motion and crepitation. Her temperature rose occasionally to 99° F.

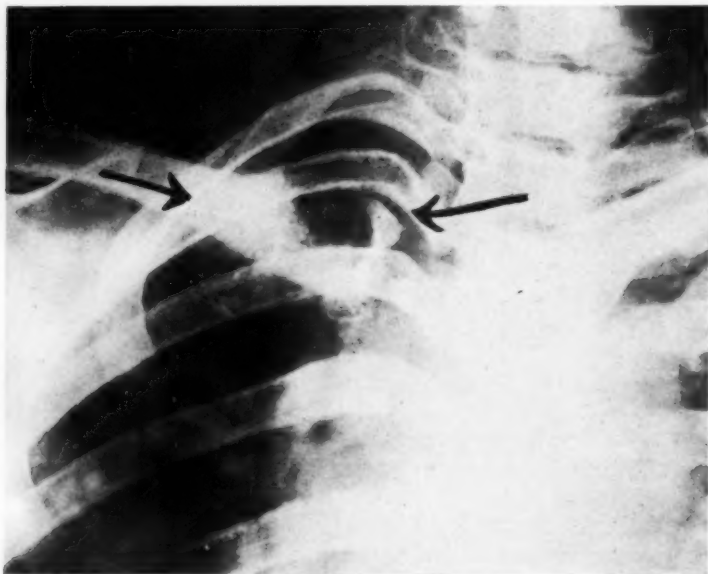


Fig. 4. Case 5: Roentgenogram of the right clavicle exhibiting a destructive process in the medial end. There is an associated sclerosis just distal to the area of destruction. A roentgenologic diagnosis of syphilitic osteomyelitis was made before biopsy was done. The patient is responding well to antisyphilitic therapy but a definite swelling of the soft tissues overlying the medial aspect of the clavicle is still present. The symptomatic response in cases of syphilitic osteomyelitis is rapid, but the bony response is quite slow, and only after the patient has been under treatment for several months is there any appreciable change in the roentgenogram.

Comment: In this case the pathological process was not characteristic of any bone tumor, but the possibility of syphilitic osteomyelitis was not considered and a diagnosis of osteochondroma was made. The destructive process with fragmentation should have led to the proper diagnosis.

CASE 4: A. T., a colored female, age 36, came into the hospital on Nov. 1, 1938. One year previous to admission she had experienced a severe headache which was followed by pain in the right shoulder joint. This disappeared and was followed by pain in the right elbow. The pain became progressive and extended to numerous other joints, with limita-

Laboratory findings were: Bence-Jones protein negative; white blood cells 12,750; hemoglobin 60 per cent; blood sugar 64 mg. per 100 c.c.; non-protein nitrogen 27 mg. per 100 c.c.; creatinine 1.5 mg. per 100 c.c.; Kahn test 4+.

A biopsy was done and reported as follows by Dr. Walter Schiller of Cook County Hospital, Chicago: chronic inflammatory disease, either Paget's (?) or syphilitic osteomyelitis.

Roentgenograms (Fig. 3) exhibit a fairly generalized destructive process involving both clavicles, right scapula, right knee, right ischium, and upper end of the right femur. The process is mostly destructive, with the exception of the lateral portions of both clavicles, where there is a marked deposit of calcium within the soft tissues, as well as

bone destruction. There is very little evidence of periosteal proliferation.

The patient was placed on antisyphilitic therapy and a remarkable response was noted. She gained weight, pain disappeared, and she became ambulatory and was discharged from the hospital in December 1938. She returned to the clinic on Feb. 7, 1939, still further improved, and more roentgenograms were made. On March 16, she was readmitted with the possibility of cerebral syphilis. She was again discharged and no further follow-up was available.

nation revealed a firm enlargement on the medial aspect of the right clavicle with a draining sinus. The area was sensitive to pressure.

The Kahn test was negative. Biopsy revealed syphilitic osteomyelitis.

A roentgenogram of the right clavicle (Fig. 4) shows a destructive process involving the medial end, with a large area of rarefaction associated with sclerosis. Conclusions: Syphilitic osteomyelitis.

Comment: This case illustrates one of the areas commonly involved in syphilitic



Fig. 5. Case 6: Roentgenogram revealing a destructive process (arrows) involving the left clavicle, with some periosteal proliferation. There was an overlying soft tissue mass in the region of the fifth rib. A biopsy of this area was done and a diagnosis of syphilitic osteomyelitis was made. The patient also had a destructive process in the lateral aspect of the left ilium. This case again demonstrates the multiplicity of lesions seen quite frequently in syphilis. A roentgenologic diagnosis of syphilitic osteomyelitis was made before the biopsy and before the Kahn reaction was known.

Comment: This patient exhibits an unusual type of generalized bone syphilis resembling to a marked degree generalized osteolytic metastases. We believe the deposit of calcium in the soft tissues in both acromio-clavicular areas rules out metastatic cancer. The roentgen findings are not at all similar to those of Paget's disease, no characteristic broadening of the trabeculae with resorption of the calcium being present. The history and subsequent course of the disease also rule out any possibility of Paget's disease.

CASE 5: M. P., a colored female, age 28, was first seen in our clinic with a tender swelling on the inner side of her right collar bone. This had been present for one year and was very painful. Physical exami-

osteomyelitis. The draining sinus cleared up very soon after antisyphilitic therapy was instituted. Two manifestations of syphilitic osteomyelitis were present, namely, necrosis and sclerosis. The negative Kahn test may be misleading but is not unusual in such cases, especially if the patient has had previous inadequate antisyphilitic therapy.

CASE 6: A. C., a colored female, age 23, was first seen in May 1941, complaining of a 25-pound weight loss in six months. She also complained of pain in the left collar bone, right chest, and left hip. There was a painful mass over the fifth rib anteriorly on the right. This was tender, was fixed to the rib, and measured about 3 cm. in diameter. There was also tenderness to pressure over the left clavicle and over the lateral aspect of the left ilium.

The Kahn test was 3+. Biopsy of the rib lesion was done and a diagnosis of syphilitic osteomyelitis was made.

Roentgenograms reveal some small mottled areas of rarefaction in the fifth rib anteriorly on the right side. In addition, a destructive process in the left clavicle associated with some widening of the bone and sclerosis is seen. There is a destructive process in the medial portion of the right clavicle with definite destruction of the trabeculae (Fig. 5). One small circumscribed area of rarefaction is noted in the left ilium.

Comment: This case illustrates the multiplicity of the lesions of syphilitic osteomyelitis and the variable roentgen manifestations.

CASE 7: A. H., a colored female, age 32, came to the hospital complaining of a draining area over the left collar bone, of one month's duration. Physical examination exhibited a draining sinus over the left mid-clavicular area associated with swelling and tenderness.

Biopsy was attempted but the results were unsatisfactory. The Kahn test was 4+; the white blood cell count 7,950.

A roentgenogram of the left clavicle (Fig. 6) reveals thickening of the cortex with considerable sclerosis. No evidence of destruction is present.

Comment: The microscopic examination was not satisfactory due to the fact that no blood vessels were present in the specimen. It is important that vessels be present, as it is difficult to make a definite diagnosis of syphilitic osteomyelitis without perivascular lymphocytic infiltration. In view of the positive Kahn test and the symptomatic improvement following antisiphilitic therapy, the author believes that the diagnosis of syphilitic osteomyelitis is justified, although a non-suppurative osteomyelitis of non-specific origin may give an identical appearance on the roentgenograms.

CASE 8: F. C., a white male, age 65, who was known to have had taboparesis for many years, complained of a fairly large swelling over the inner aspect of the left clavicle. The mass had been present for several months and had become progressively larger. It measured about 6 cm. in diameter and apparently involved the medial aspect of the clavicle. It was somewhat soft and was sensitive to pressure.

A Kahn test on the spinal fluid was positive.

Roentgenograms reveal a complete destruction of the medial third of the left clavicle (Fig. 7).

There is a large amount of haziness over this area due to the overlying soft tissue mass. A teleroentgenogram of the chest shows a definite dilatation of the ascending aorta, which very probably represents a syphilitic aortitis.

Comment: The lesion in this case was destructive, with no evidence of periosteal proliferation or sclerosis. The remaining portion of the clavicle was entirely normal. The possibility of a metastatic lesion was at first very strongly considered but was discarded when further clinical data were obtained.

CASE 9: S. F., white male, age 56, was first seen in the hospital complaining of a swelling and tenderness of the third finger of the left hand. There was, in addition, a small, firm, tender nodule on the forehead. Physical examination showed a fusiform swelling of the third finger of the left hand. It felt very firm and was sensitive to pressure. In the frontal area of the skull was a nodule about 1 cm. in diameter. It was not movable, being attached to the bone.

Laboratory examinations gave the following results: Kahn test 4+; blood cholesterol 260 mg. per 100 c.c.; hemoglobin 12.24 gm.; white cells 15,360; urine negative. Biopsy was not done.

Roentgenograms (Fig. 8) exhibit a destructive process in the proximal phalanx of the middle finger of the left hand. There is an area of rarefaction associated with considerable periosteal proliferation. A small area of rarefaction is also noted in the distal half of the fourth metacarpal, and there is some periosteal proliferation along the shaft. A similar area of destruction is noted in the left side of the frontal bone of the skull. Both tibiae show thickening of the bone along the anterior aspect, while in the right tibia there is associated bone destruction. The ascending aorta is dilated; the findings suggest syphilitic aortitis.

The patient was put on antisiphilitic therapy with clinical improvement but disappeared from observation.

Comment: This case again illustrates the multiplicity and variable manifestations of syphilitic osteomyelitis. At first a generalized neoplastic process was suspected, but the variable appearance was not consistent with any neoplasm and the diagnosis of syphilitic osteomyelitis was made from the roentgenograms.

DISCUSSION

These nine cases illustrate the difficulties encountered in making a diagnosis of



Fig. 6 (above). Case 7: Roentgenogram of the left shoulder region showing marked sclerosis of the left clavicle. No evidence of destruction is present. The patient also had a draining sinus. This is the fairly typical appearance of periostitis and osteitis due to syphilis, but a sclerosing osteomyelitis of non-specific origin may produce an identical picture. The draining sinus, swelling, and tenderness disappeared after antisyphilitic therapy.

Fig. 7 (below). Case 8: Roentgenogram of chest, exhibiting a destructive process destroying completely the medial third of the left clavicle. The process stops rather abruptly and the bone distal to this area is fairly normal. The haziness in the region of destruction represents an overlying large soft tissue mass. This patient had had taboparesis for years and had a positive spinal fluid Kahn reaction.



Fig. 8. Case 9: The roentgenogram of both hands (C) reveals a fusiform deformity of the soft tissues of the middle finger with a destructive process involving the distal portion of the proximal phalanx. This destructive process is associated with some periosteal proliferation. The distal portion of the shaft of the fourth metacarpal shows a small rounded area of destruction (arrows) with a very small amount of periosteal proliferation on the lateral aspect (arrows). There is also some periosteal proliferation on the medial aspect of the distal part of the shaft of the second metacarpal (arrows). Postero-anterior view of the skull (B) shows a small area of bone destruction in the left side of the frontal bone (arrows). A small soft tissue mass was also present overlying this region. The right tibia (A) shows periosteal proliferation along the medial aspect of the shaft in its distal third (arrows), with some thickening of the cortex along the anterior aspect. A diagnosis of syphilitic osteomyelitis was made roentgenologically before confirmatory evidence was obtained.

syphilitic osteomyelitis. In Case 2 an osteogenic sarcoma was suspected. Case 3 showed evidence of a benign tumor with a pathological fracture, while Case 4 exhibited a generalized bone involvement which was not unlike generalized osteolytic metastases. The diagnosis of syphilitic osteomyelitis in Case 4 was looked upon with so much doubt that the slides were

sent to Dr. Schiller for confirmation. Several of the other cases did not exhibit an entirely characteristic appearance. Upon very close analysis, however, the roentgenologic findings in the nine cases are not characteristic of any of the bone conditions which they simulated. Familiarity with the bone lesions caused by the *Spirochaeta pallida* will make the diagnosis of syphilitic

osteomyelitis possible in a high percentage of cases.

SUMMARY

1. Nine cases of bone involvement secondary to acquired syphilis have been discussed and the roentgenograms of eight cases reproduced.

2. Too much emphasis should not be placed on a negative Kahn test, especially if the patient has received any anti-syphilitic therapy.

3. All syphilitic bone lesions should be referred to as syphilitic osteomyelitis.

4. Syphilitic osteomyelitis may simulate any type of bone pathology. The simulation is not complete, however, as some of the characteristic changes of the other bone lesions are not present. A proper evaluation of the various findings present on the roentgenograms should permit a correct diagnosis.

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Diseases of the Mediastinum and Associated Conditions¹

A Refresher Course

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THIS DISCUSSION includes those diseases and conditions which may produce abnormal shadows in and adjacent to the mediastinum. Cardiac and vascular lesions are not included except where they need to be differentiated from other mediastinal masses. Those diseases in which the major roentgenological manifestations are in the pulmonary parenchyma are discussed briefly, if at all, since the roentgen diagnosis is based more on the pulmonary changes than on mediastinal variations.

As with other regions of the body, it is possible to classify mediastinal lesions in various ways. The classification given below is based on the anatomical structures contained within the mediastinum and has the advantage of relative simplicity. Also it is essential in the differential diagnosis to determine, first of all, the anatomical division of the mediastinum involved and, second, if possible, the structure or structures which may have given rise to the abnormality in question. Once this has been accomplished, the diagnostic possibilities become limited.

I. Diseases of the mediastinal lymph nodes

Infections

Non-specific lymphadenopathy

Acute and chronic

Fungus infections

Tuberculosis

Primary tuberculosis

Hyperplastic tuberculosis

Associated with caseous tuberculosis

Associated with erythema nodosum

Boeck's sarcoid

Asymptomatic form

Tumors of the mediastinal lymph nodes

Primary malignant

Hodgkin's disease, lymphosarcoma, leukemia, aleukemic leukemia

Metastatic tumors

II. Primary tumors of mediastinum other than lymph node tumors

Benign

Lipoma, fibroma, dermoid cyst and teratoma, chondroma, ganglioneuroma, neurofibroma, cystic hygroma

Malignant

Fibrosarcoma, neurofibrosarcoma, liposarcoma, thymoma

III. Mediastinitis

Acute mediastinitis

Acute diffuse mediastinitis

Acute mediastinal abscess

Chronic mediastinitis

Chronic mediastinal abscess

Chronic diffuse or fibrous mediastinitis

Mediastinopleural (paramediastinal) effusion

Mediastinal emphysema

IV. Diseases of the thyroid and thymus

Thymic hyperplasia in children

Thymic tumors

Enlarged thyroid, substernal thyroid and intra-thoracic goiter

V. Diseases of the spine

Tuberculosis and other infections

Tumors

VI. Cardiovascular lesions

Enlarged left auricle

Aneurysm of aorta

Right-sided aorta

Pulmonary artery dilatation

Aneurysm of innominate artery

VII. Diseases of esophagus and stomach

Cardiospasm

Esophageal hiatus hernia and thoracic stomach

VIII. Bronchogenic carcinoma

ANATOMY OF THE MEDIASTINUM

The mediastinum is defined as that space lying between the right and left pleurae, in and near the median sagittal plane of the chest (Fig. 1). It extends from the sternum in front to the vertebral column behind and contains all the thoracic viscera except the lungs. For convenience in description anatomists usually divide it into four parts, the superior, anterior, middle, and posterior spaces (4). Such a division is useful roentgenologically, since the various spaces can be recognized

¹ From the Department of Radiology and Physical Therapy, University of Wisconsin Medical School and the State of Wisconsin General Hospital, Madison, Wisconsin.

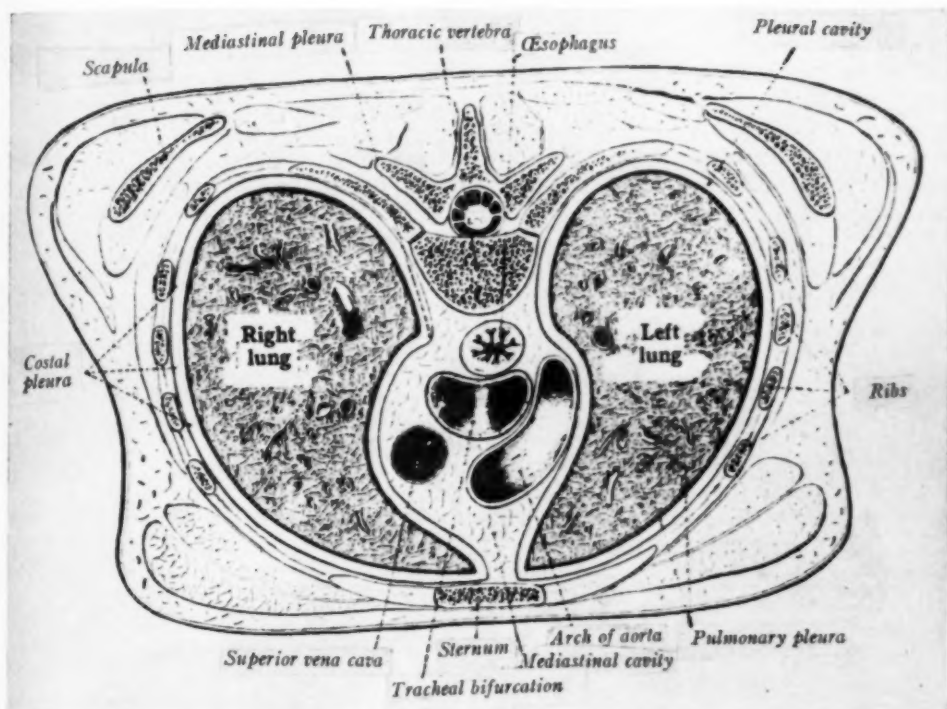


Fig. 1. Cross-section diagram of the mediastinum at the level of the tracheal bifurcation. Note how both the anterior and posterior mediastinal spaces would be obscured in frontal roentgenograms by the heart and great vessels. (From Sobotta and McMurrich's *Atlas and Textbook of Human Anatomy*.)

in roentgenograms. The *superior mediastinum* is the portion between the manubrium sterni in front and the upper four thoracic vertebrae behind. Within it are the aortic arch, innominate artery and thoracic portions of the left common carotid and left subclavian arteries, the innominate veins and the upper half of the superior vena cava, the trachea, esophagus, thoracic duct, thymus, some lymph nodes, and various nerves. The *anterior mediastinum* is bounded in front by the sternum, laterally by the pleura, and posteriorly by the pericardium. Its contents consist of loose areolar tissue, some lymphatic vessels which ascend from the convex surface of the liver, and a few lymph nodes. The *middle mediastinum* is the broadest part of the interpleural space. It contains the heart enclosed in the pericardium, the ascending aorta, the lower half of the superior vena cava with the azygos vein emp-

tying into it, the bifurcation of the trachea, the two main bronchi, the pulmonary artery and its two branches, and some bronchial lymph nodes. The *posterior mediastinum* is an irregular triangular space parallel with the vertebral column. It is bounded in front by the pericardium and heart above, and by the posterior surface of the diaphragm below; behind by the vertebral column from the lower border of the fourth dorsal to the twelfth, and on either side by the mediastinal pleura. It contains the thoracic part of the descending aorta, the azygos and two hemiazygos veins, the esophagus, thoracic duct, some nerves, and lymph nodes.

The mediastinal lymph nodes are similarly divided into three major groups (Fig. 2). The *anterior mediastinal nodes* are found in the anterior part of the superior mediastinum, in front of the aortic arch and in relation to the innominate veins

and the large arterial trunks which arise from the aortic arch. The *posterior mediastinal nodes* lie behind the pericardium in relation to the esophagus and descending aorta. The third and most important group, roentgenologically, is known as the *tracheo-bronchial* and consists of the paratracheal nodes lying on either side of the trachea; the bronchial or bifurcation nodes

than with the bronchi which supply either the middle or the lower lobe of the right lung (10).

ROENTGEN ANATOMY OF THE MEDIASTINUM

Technical Aspects of Examination: Thorough study of the mediastinum requires both fluoroscopic examination and films. The type and number of films may

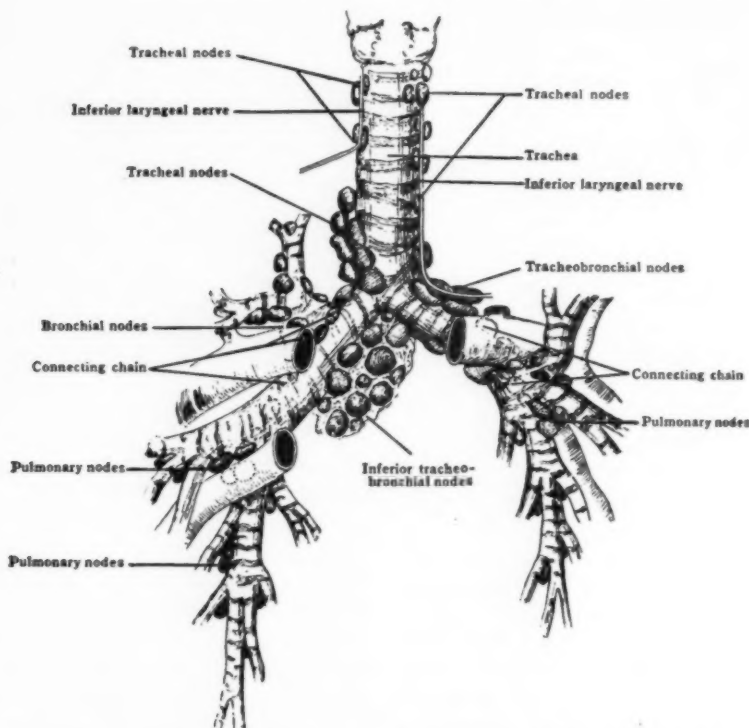


Fig. 2. Diagram of mediastinal lymph node distribution. (From Morris' *Human Anatomy*.)

lying in the angles between the lower part of the trachea and the bronchi and in the angle between the bronchi; the broncho-pulmonary or hilum nodes situated in the hilum of each lung; and the pulmonary nodes, found in the lung substance on the larger branches of the bronchi. Anatomists have recognized that there is a greater number of lymph nodes associated with the right lung and also that there is a greater number of nodes associated with the eparterial bronchus (right upper lobe)

be determined most advantageously after preliminary fluoroscopy. Generally, postero-anterior and lateral views comprise a minimum; oblique films may be of value in some cases. When the diagnosis of a given lesion is in doubt, the esophagus should be investigated with opaque material; the spine and sternum may be the source of abnormal shadows. Kymographic study may be of some use in determining whether a lesion is of cardiac or vascular nature, although fluoroscopy will

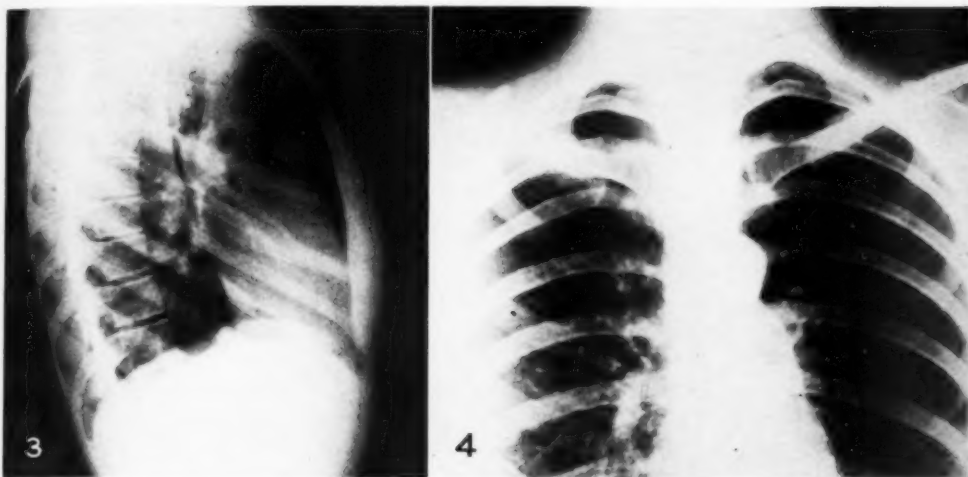


Fig. 3. Normal lateral roentgenogram of the mediastinum. The various anatomical subdivisions can be recognized in this view.

Fig. 4. Normal frontal roentgenogram of the mediastinum of a young adult female. The left border of the subclavian artery and its junction with the aorta can be recognized. Disruption of the smooth curve of this shadow or a filling out of the normal concavity at the junction of these vessels may be the earliest evidence of enlargement of the paratracheal lymph nodes. The innominate vessels and the superior vena cava often can be identified on the right side. The normal hilum shadow is composed of a network of striated densities and occasional small circular shadows, without specific arrangement.

usually give equally good information. It is probably unnecessary and unwise to employ a standard technic for examination of the mediastinum, being better rather to vary the procedure, depending upon the possibilities in the individual case. It should be remembered that the mediastinum contains many different structures, most of which may, at times, be responsible for abnormal roentgen shadows.

Lateral View of the Mediastinum: The lateral view of the chest demonstrates to the best advantage the four anatomical divisions of the mediastinum (Fig. 3). The *posterior part of the superior mediastinum* ordinarily is not seen and is best demonstrated in lateral views of the neck. This area is of importance because it is a common site of mediastinal abscess formation due to extension of retropharyngeal infection. The *anterior part of the superior mediastinum* may be encroached upon by substernal extension of the thyroid, enlargement of the thymus, aneurysm of the aortic arch and vessels arising from the arch, and by enlargement of its lymph

nodes. The *anterior mediastinum* is seen as a relatively clear space between the sternum anteriorly and the heart posteriorly. It is roughly triangular, with the apex pointing downward where the heart comes in contact with the sternal shadow. Posteriorly it is usually well demarcated by the cardiac shadow. It is important, roentgenologically, because of the presence of lymph nodes; its space is one of the weak spots of the mediastinum and when herniation of the lung occurs it usually does so through this area; enlargements of the thymus, thymic tumor, and substernal goiter may extend into it; it is a common location for dermoid cysts and teratomata. The *middle mediastinum* also is well defined in the lateral view, containing as it does the heart and aorta. For the purposes of this discussion, its importance lies in the groups of lymph nodes clustered about the trachea and bronchi. The *posterior mediastinum*, lying between the heart and spine, shows a radiolucency about equal to that of the anterior mediastinal space. It may be encroached upon

by cardiac enlargement, particularly the left auricle, or by masses arising from the spine; it is the common site for deep mediastinal infection and abscess formation; dilatation of the esophagus and herniation of the stomach through the diaphragm may give rise to abnormal masses within it. Among the benign mediastinal tumors,

artery which usually can be traced upward, curving smoothly to the left beneath the clavicle (Fig. 5). Below this the border is formed successively by the transverse aortic arch, left hilum of the lung overlying the pulmonary artery, and the left ventricle. On the right, superiorly, the margin is

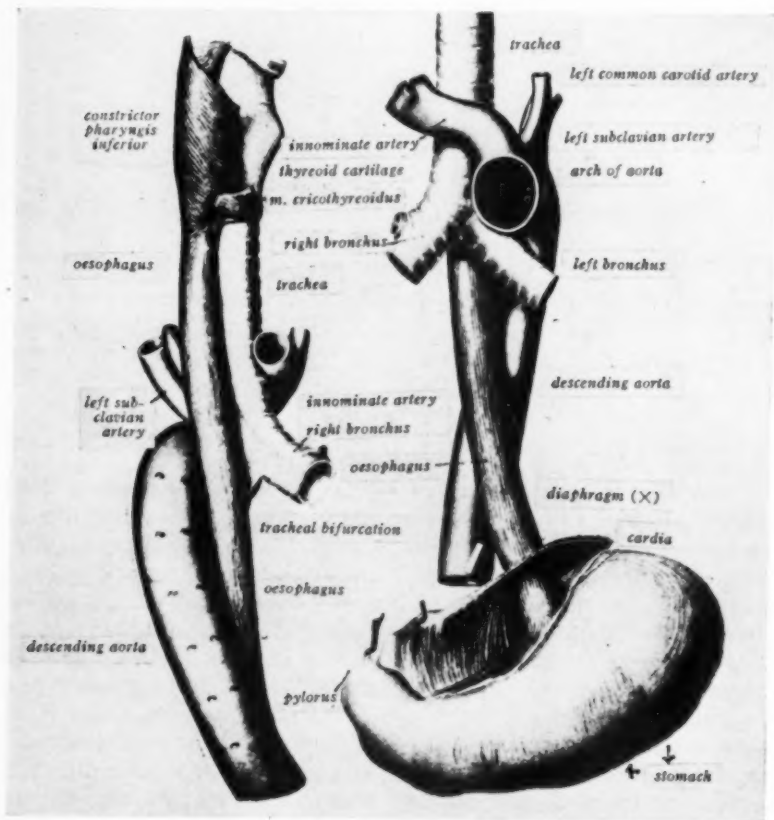


Fig. 5. Anatomical relationships of aorta, esophagus, and trachea. Compare this diagram with the roentgenogram in Fig. 4. (From Sobotta and McMurrich's *Atlas and Textbook of Human Anatomy*.)

ganglioneuroma and neurofibroma are most commonly located along the lateral margins of this space.

Frontal View: The mediastinum and its contents together with the dorsal spine and sternum form the "central shadow" seen on the normal chest roentgenogram (Fig. 4). Superiorly on the left, the outer border is formed by the left subclavian

and below by the superior vena cava, ascending arch of the aorta, right hilum of the lung, and right auricle. Visualization of the mediastinal structures in this view depends largely upon the technic of the examination and particularly upon the penetration used. Since the middle portion of the mediastinum is the widest and contains the heart, the anterior and pos-

terior spaces are largely hidden in films made with the usual chest technic. The frontal view can be of great value, however, if the films are deliberately overexposed or are made with a Potter-Bucky diaphragm. For study of early enlargement of the paratracheal nodes, the frontal view often is more satisfactory than the lateral (Fig. 6). The major portion of the trachea is seen as a dark band-like shadow overlying the dorsal spine in ordinary chest films, but for clearer visualization of the entire trachea and the major bronchi, the use of overpenetrated films or body section roentgenography is necessary. This latter procedure is particularly valuable in this respect. The borders of the aorta, especially the descending portion, are best seen in films made with the Potter-Bucky grid, and the same is true of the spine and paraspinal soft tissues. The esophagus can be outlined with opaque mixtures. Complete study of mediastinal mass shadows may require all these procedures and they should not be neglected unless the diagnosis is obvious on routine examination.

I. DISEASES OF MEDIASTINAL LYMPH NODES

General Considerations: Pathologically, the mediastinal lymph nodes are involved in practically all infections of the lungs and bronchi, with a resulting acute or chronic lymphadenopathy. Roentgenologically, such lymphadenopathy is of relatively little importance in most infections since it does not reach a stage where it can be detected. The exceptions occur in primary tuberculosis, hyperplastic tuberculosis, and certain fungus infections. Also, in rare instances a lymph node may undergo suppuration and abscess formation. Fundamentally, then, in any well defined mediastinal lymphadenopathy the only infections that need to be considered are tuberculosis, certain fungus infections, and, rarely, acute mediastinal lymphadenopathy. Involvement of the lymph nodes by primary tumor formation occurs in Hodgkin's disease, lymphosarcoma, lymphatic leukemia, aleukemic leukemia, and in some instances of myeloid leukemia. It is impossible, as a



Fig. 6. Minor enlargement of the paratracheal nodes in a case of Hodgkin's disease.

rule, to distinguish these lesions from one another on roentgen examination, and even at necropsy absolute differentiation cannot always be made. Thus, the general use of the term lymphoblastoma to include this group of diseases will be found satisfactory. The lymph nodes may be involved secondarily to any malignant tumor and there are no roentgen characteristics to help determine the nature of the primary lesion as far as the lymph node changes are concerned.

For practical purposes and from the standpoint of differential diagnosis, if one has determined that distinct or generalized mediastinal lymphadenopathy exists, the lesions that must be considered are: (1) tuberculosis, (2) coccidioidomycosis, (3) lymphoblastoma, and, (4) metastases. When involvement of the mediastinal lymph nodes occurs in any of these diseases, early detection is possible only when the marginal nodes are involved, due to the contrast afforded by the adjacent air-containing lungs. These marginal nodes include the paratracheal, the outer groups of bronchial nodes lying in the angles between the trachea and either bronchus, and the peripheral hilum nodes. No one group of

these nodes is involved predominantly by any one disease. Involvement of the right paratracheal group has been said to occur in Hodgkin's disease more than in any other, but in our experience this has not been true. This group of nodes is often more prominent than the others when enlargement is generalized, regardless of the cause. A possible explanation is the larger number of nodes in this region as compared to the left.

Infections of the Lymph Nodes

Acute Non-specific Lymphadenopathy

The lymph nodes are involved in the various infections of the lungs and bronchi. The nodes seldom increase in size, however, sufficiently to be detectable. Some enlargement of the hilum shadow or shadows occurs uniformly in pneumonia. This may be due in part to vascular dilatation but ordinarily this change plays a slight rôle in the diagnosis, which is based more on the character of the lesions in the pulmonary parenchyma. In measles and pertussis a mild degree of hilum enlargement may be present. Again, in most instances, this is insufficient to be distinguished from the normal variations in the hila of children. When definite, the hilum shadows are enlarged symmetrically, the borders are fuzzy, and no smooth, discrete nodules can be identified. Areas of bronchopneumonia may or may not be present. The history and observation over a relatively short period of time are sufficient to establish the cause. In an occasional instance an infected lymph node may undergo suppuration and abscess formation as elsewhere in the body. This may lead to acute mediastinitis or mediastinal abscess (p. 27).

Chronic Non-specific Lymphadenopathy: As with the acute infections, most chronic inflammatory processes of the lungs and bronchi cause varying degrees of chronic lymphadenopathy but, with certain exceptions, the nodes seldom become enlarged sufficiently to be identified on roentgen examination.

In long standing chronic bronchitis, bronchial asthma, and bronchiectasis a

moderate increase in density of the hilum shadows is the rule. This is difficult to differentiate from the normal variations and the usual changes concomitant with advancing age. An exception occasionally is seen when the bronchopulmonary infection is associated with chronic sinusitis, the so-called bronchosinusitis syndrome. In this condition the hila show a more distinct thickening and increased density than is seen in most other chronic non-specific infections. The process is generally bilateral; the enlarged nodes produce a soft, fuzzy hilum accentuation; extending downward from the hila to the medial lung bases, soft striated opacities in excess of the normal are visible. Iodized oil studies may or may not show bronchiectasis. This combination of hilum and basal peribronchial thickening usually is characteristic enough so that the diagnosis can be made without difficulty. Roentgenograms of the nasal sinuses will reveal evidences of chronic sinusitis and substantiate the diagnosis.

Fungus Infections: While numerous fungi have been held responsible for the production of pulmonary and mediastinal lymph node lesions, it is doubtful if most of them are pathogenic. It seems to be reasonably well established that in most cases where fungi of various types are found in the sputum, they are secondary invaders, and some other disease, such as tuberculosis, carcinoma, bronchiectasis, etc., is responsible for the roentgen and clinical findings. It is admitted that in some instances these saprophytic organisms may become pathogenic. Thus, *Monilia* may cause an infection of the bronchi and rarely of the lungs. This is apparently a relatively mild process, and tissues for histologic examination are difficult to obtain. While some change may be produced in the lung fields and in the peribronchial trunks, it has been our experience that distinct mediastinal abnormality is not present. The fungi which are known to be pathogenic and to involve the lungs and mediastinum are *Actinomyces*, *Blastomyces*, and *Coccidioides immitis*. *Aspergillus*, *Streptothrix*, and *Torula* infections are infrequent.

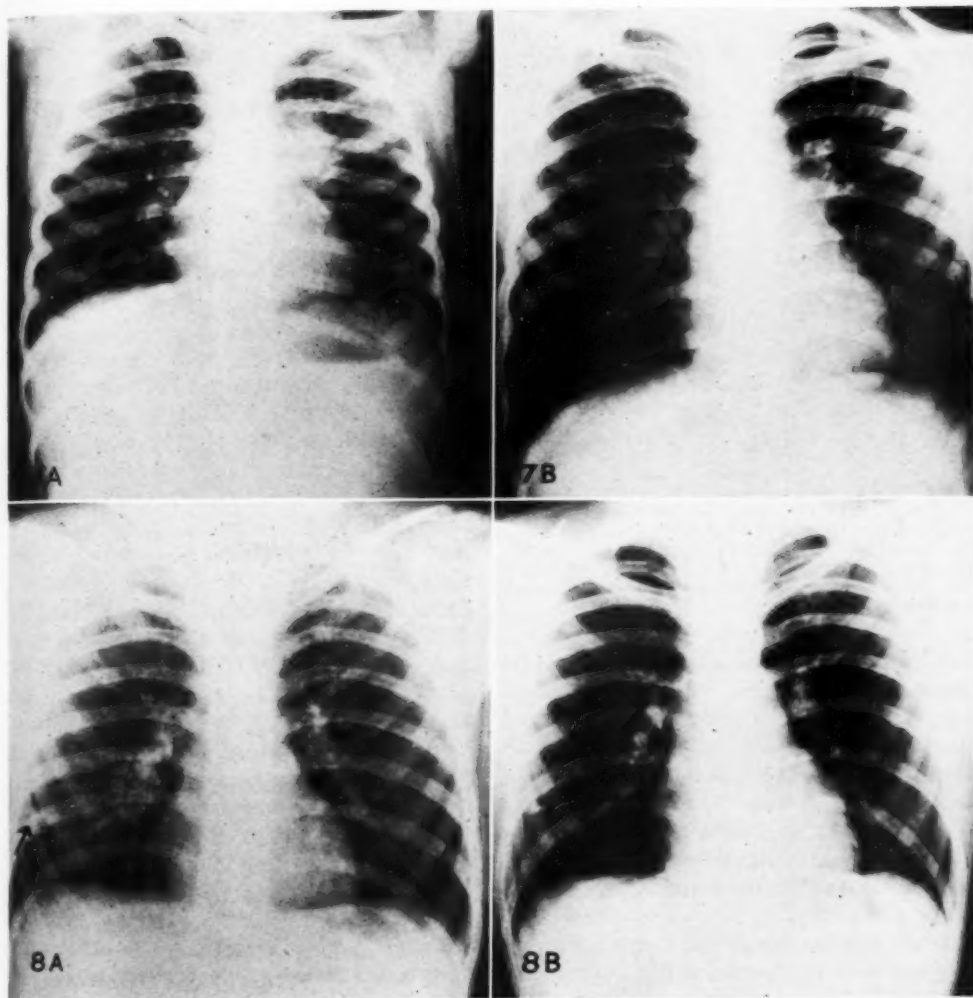


Fig. 7. Primary tuberculosis. A. Appearance during a relatively early phase of the disease. The involvement is unilateral with soft increase in the left hilum shadow, fuzzy outer margins, and indefinite soft striations throughout the upper lobe region. B. Three years later. The hilum enlargement has resolved, leaving a few flecks of calcium. The parenchymal focus is now obvious, containing a tiny dense center of calcium.

Fig. 8. Primary tuberculosis. A. The lower right hilum has a mottled appearance with fine flecks of calcium. The primary focus is faintly defined (arrow). B. Six years later. The primary focus now is a dense spot of calcium; the lymph nodes have regressed and calcified.

Actinomycosis and blastomycosis seldom involve the mediastinum primarily, and the pulmonary and pleural lesions are the major ones. Thus in actinomycosis, encapsulated empyema, lung abscess, and osteomyelitis of the ribs may all be present in the individual case and, even though the mediastinum, too, is invaded, it is only a part of the picture. We have never en-

countered a case of actinomycosis or blastomycosis limited to the mediastinum or its lymph nodes. In a few instances rarer fungus infections, such as torulosis, have been encountered, but they have appeared as chronic inflammatory parenchymal lesions without mediastinal involvement.

Coccidioidomycosis is a fungus infection caused by the *Coccidioides immitis*. In

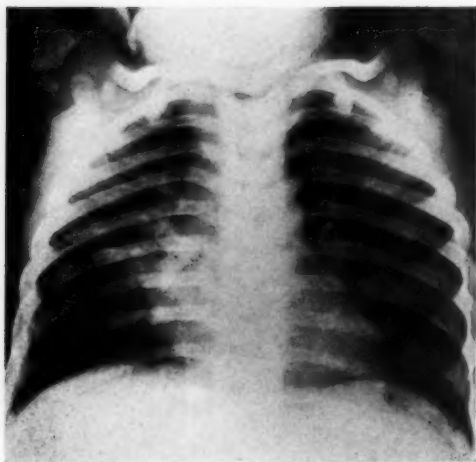


Fig. 9. Acute pneumonitis simulating primary tuberculosis. Patient, admitted for repair of cleft palate, gave a history of a "chest cold" several weeks previously. The chest film shows a soft, patchy density affecting the right hilum and adjacent lung. The Mantoux test was negative and a month later the lesions had resolved.

this country it is limited almost entirely to the state of California, with a few cases reported from other localities. It has been shown that primary infection with this organism may attack the lungs and mediastinal lymph nodes. The disease may run an asymptomatic course or there may be evidence of an acute respiratory infection, at times with an associated erythema nodosum. Roentgenograms of the chest show enlargement of the hilum shadows and areas of soft infiltration in the lung parenchyma. The differentiation from tuberculosis may be impossible on x-ray examination, but the diagnosis is established by finding the organisms in the sputum or gastric contents. Skin testing with coccidioidin is a helpful procedure in determining the presence of specific allergy to the fungus (1, 2, 3).

Tuberculosis

Primary Tuberculosis: Two major roentgenologic forms of primary tuberculosis may be recognized: (a) involvement limited to the mediastinal nodes and (b) mediastinal node involvement plus parenchymal lesions.

(a) *Lymph node type:* While no visible parenchymal focus may be demonstrable, such a lesion is or has been present, since the lymph node lesions are considered to be secondary. Failure to demonstrate the parenchymal focus may be due to its small size or it may have resolved in advance of lymph node resolution (Fig. 7). Involvement may be unilateral or bilateral. It is rather common to find the lesion limited to one group of nodes, as those in one hilum or in one paratracheal area. While great variation exists, the general pattern is that of soft lobulated shadows affecting an entire hilum. These, while they may be distinctly nodular, lack sharp outer borders during the acute stage. Resolution is a slow process, often requiring several years. During this phase the shadows regress in size, the outer margins become more distinct, and flecks or larger deposits of calcium frequently become visible (Fig. 8). When calcium is present, the diagnosis is more readily made; if it is present on the first examination, the lesion can be assumed to be of months' if not of several years' duration. Differentiation from the acute lymphadenopathy of pertussis and measles can be made by the history and observation; from lymphoblastoma by the fuzzy margins, presence of calcification, frequent absence of clinical symptoms, and the relatively slight change in appearance over an interval of time, indicating the benign nature of the process. Not infrequently the lymph node changes are minimal and can be confused readily with the normal. The variations in the extent and density of the normal hilum shadows in children are well known. We are of the opinion that roentgenologists should be conservative in their interpretation of these structures and a knowledge that a given child has a positive tuberculin test should not influence judgment in calling a borderline shadow pathological. The primary focus may be elsewhere than in the lungs and when in the lungs may produce no lesion gross enough to result in roentgenologic shadows. When the lesion is unilateral, minor degrees of enlargement are more readily appreciated.

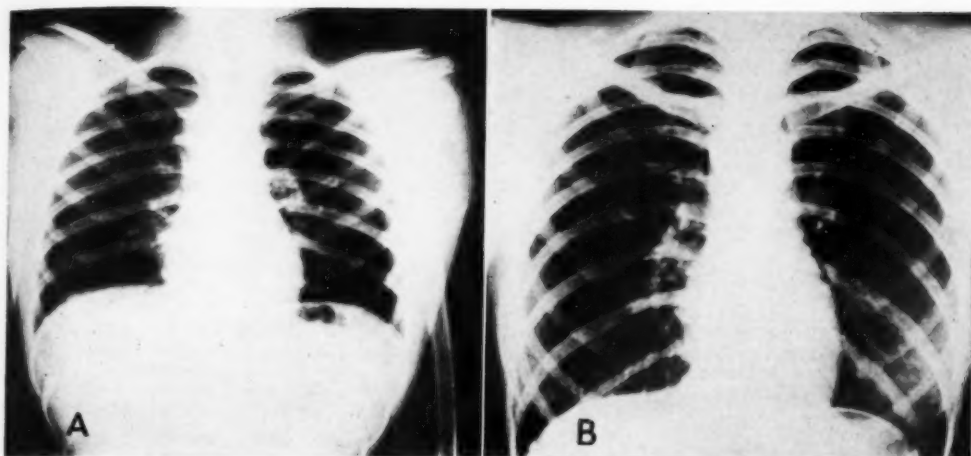


Fig. 10. Primary tuberculosis simulating a tumor of the mediastinum. Failure to gain weight after "influenza" several months before; intermittent fever and weakness. Mantoux test positive. A. Smooth, rounded mass in the right paratracheal area. B. Six years later. The mass has regressed and now there is an oval, mottled calcified lymph node at the site of the original mass (arrow). This is well demonstrated in the original film but does not reproduce well. No primary focus is visible.

(b) *Parenchymal and lymph node type:*

As far as the lymph node changes are concerned, they are identical with those described above. The parenchymal lesion may be single or multiple, small or large, and may be found in any part of the lung or lungs. It may occur as an area of soft homogeneous opacity adjacent to or merging with the hilum or it may be a wedge or patch of soft density out in the lung field. In either event the lesions have the roentgen appearance of pneumonic foci when acute, and roentgen differentiation from pneumonia may be impossible (Fig. 9). Correlation with the clinical picture makes the diagnosis less difficult. Again, the relative lack of symptoms and the chronic course are of great importance. A positive Mantoux test is generally present but a negative Mantoux does not rule out tuberculosis with absolute certainty. Visible calcium deposition in the primary focus or in the lymph nodes occurs in about one-fourth of those primarily infected. In some instances the mediastinal lymph node enlargement is confined to the more deeply situated nodes. In such cases, overpenetrated films and lateral views are of value. In exceptional instances the lymph node

enlargement may take the form of smooth discrete masses localized to a group of nodes (Fig. 10). Such masses are extremely difficult to differentiate from other lesions and may require observation over a period of months before a final answer can be given. In young white adults, in contrast to young children, primary infection with the tubercle bacillus seems to cause little or no lymphadenopathy, but the process is essentially in the lung parenchyma and simulates closely the infiltrate of reinfection tuberculosis.

Hyperplastic Tuberculosis: Hyperplastic tuberculosis is characterized by a tendency to cause well defined enlargement of the mediastinal lymph nodes with or without associated parenchymal lesions, involvement of the mediastinal nodes with little or no enlargement of peripheral nodes, a relatively benign clinical course with few symptoms referable to the chest, and a tendency for gradual, slow resolution. When peripheral nodes are available for biopsy, the lesions are of the hyperplastic type with caseation notably absent. This type of tuberculosis is more common in young and middle-aged adults and there may be an associated *erythema nodosum*.



Fig. 11. Enlarged mediastinal nodes with erythema nodosum. White male, age 24, with erythema nodosum as the chief complaint. Extensive mediastinal adenopathy is apparent. Biopsy of a cervical node showed "hyperplastic tuberculosis." Roentgen therapy was administered to the mediastinum. Eight months later (middle view) most of the adenopathy had disappeared. One year later (extreme right) the chest had returned to normal. The patient was well clinically and remained so to the last observation, five years later.

The sputum and gastric contents usually are negative for tubercle bacilli, and tuberculin anergy is the rule. The process may be confined to the lymph nodes or there may be variable degrees of parenchymal involvement. When the mediastinal and pulmonary lesions are extensive, there may be fever, dyspnea, cough, and loss of weight. While the process in the chest is essentially hyperplastic, it may progress into caseous tuberculosis, or caseous lesions may be found in other systems such as the bones or genito-urinary tract.

The degree of enlargement of the nodes is variable but often is considerable. The hilum and paratracheal groups are chiefly affected. Bilateral changes are the rule, although the enlargement is practically always asymmetrical. The enlarged nodes produce a dense hilum shadow, the outer borders of which are fuzzy but distinctly nodular. The right paratracheal group is often more prominent than the left and the outer border tends to be sharper, although seldom as distinct as in lymphoblastoma. Soft striations may be seen radiating outward from the hila into the midlung fields or toward the bases (Figs. 11 to 14). When there is associated parenchymal disease, the pulmonary lesions may vary considerably in appearance, often being widely distributed, coarsely nodular or granular, and occasionally of stringy, fibrous character. Calcification may be present in the hilum areas; when found, it

is believed to antedate the present illness. Differentiation from lymphoblastoma, especially Hodgkin's disease, may be difficult although in many instances it can be made. In untreated Hodgkin's the shadows are sharper and the borders more clean-cut; peripheral nodes are more frequently involved; the symptoms are in proportion to the degree of node involvement. Correlation with the clinical picture is important. Roentgen therapy in small doses may be tried for differential effect, hyperplastic tuberculosis showing a slower response following such treatment. If available, a lymph node should be removed for microscopic examination.

This disease in its pulmonary manifestation has been described in the literature under many names, such as hematogenous non-miliary tuberculosis, benign lymphogranuloma, tuberculous lymphoma, non-caseating tuberculosis, pseudotuberculosis, Boeck's sarcoid or pulmonary sarcoidosis, and mediastinal glandular tuberculosis.

A search for tubercle bacilli in the sputum or gastric contents seldom yields results, but warrants the effort, since in an occasional case it may be successful. Failure to find tubercle bacilli is not considered evidence that the lesion is non-tuberculous, since this is a hyperplastic rather than a caseating form of the disease.

There are at least four distinct clinico-roentgenologic forms of this disease which may be recognized, but all of them show

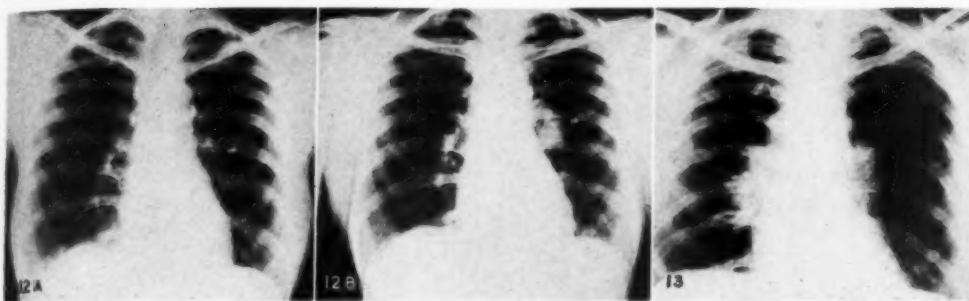


Fig. 12. Tuberculous nodes with positive sputum. A. Appearance of the chest at a previous admission. No pulmonary complaints. B. Twenty months later. Chief complaint now is "sciatica"; no pulmonary symptoms. Localized enlargement of left hilum nodes. Three gastric aspirations positive for tubercle bacilli.

Fig. 13. Uveo-parotid fever. White female, age 61, with complaints of red, sore eyes, swelling of parotid and submaxillary glands, but no pulmonary symptoms. The chest film shows a pronounced thickening of the hilum shadows, more noticeable on the right. The mediastinal lesions are no different than those seen in cases of erythema nodosum, and the histological picture has been similar, i.e., hyperplastic tuberculosis.

identical findings on histologic examination when tissue is available for study. Characteristically, the basic lesion is the epithelioid tubercle consisting of an accumulation of epithelioid cells and occasional giant cells of Langhans type, but with caseation and necrosis notably absent and with tubercle bacilli rarely found.

(a) *Association with caseous tuberculosis:* Mediastinal lesions of the type described above may be found in the presence of caseous tuberculosis elsewhere in the body, as in the joints, genito-urinary system, or in the lung parenchyma (Fig. 12).

(b) *Association with erythema nodosum:* In approximately one-third to one-half of the cases of erythema nodosum occurring in adults, enlarged mediastinal lymph nodes of the type described above have been found (13). We are of the opinion that this association indicates tuberculosis except in those areas of the country where coccidioidomycosis is prevalent (see Fungus Infections) and that, if a patient with mediastinal lymphadenopathy has or has had a recent erythema nodosum, a presumptive diagnosis of hyperplastic tuberculosis can be made (Fig. 11).

(c) *Boeck's sarcoid:* This term covers a variety of lesions, including uveoparotid fever, Jüngling's osteitis tuberculosa cystoides, skin lesions (lupus pernio), some cases of Mikulicz's syndrome, and lesions in the lung parenchyma and mediastinal lymph

nodes. A combination of these lesions may be present in the individual case. It is now recognized that, while the disease shows a predilection for the lymph nodes, it may attack any tissue or organ in the body (9). Its etiology is in dispute. Some believe it to be a distinct disease, the cause of which is unknown but possibly a virus. Others believe it is a manifestation of non-caseous (hyperplastic) tuberculosis (6, 15, 16). We subscribe to this latter view. The pulmonary and mediastinal lesions are identical with those described above, and the histological picture is the same (Fig. 13). A discussion of the arguments for and against the belief that Boeck's sarcoid is a form of tuberculosis is beyond the scope of this review. Of greater importance to the roentgenologist than the question of this relationship is the fact that the disease may simulate lymphoblastoma in its roentgen manifestations. Factors of significance in differential diagnosis are: disproportionate lack of symptoms as compared to the roentgen changes; absence of or relatively little involvement of peripheral nodes; presence of other lesions in other systems (skin, bones, lacrimal apparatus, salivary glands, etc.); tendency to a benign course with slow resolution and a return to normal; slow response to roentgen irradiation. The presence of associated fluid in the pleural cavities favors the diagnosis of lymphoblastoma, since we have

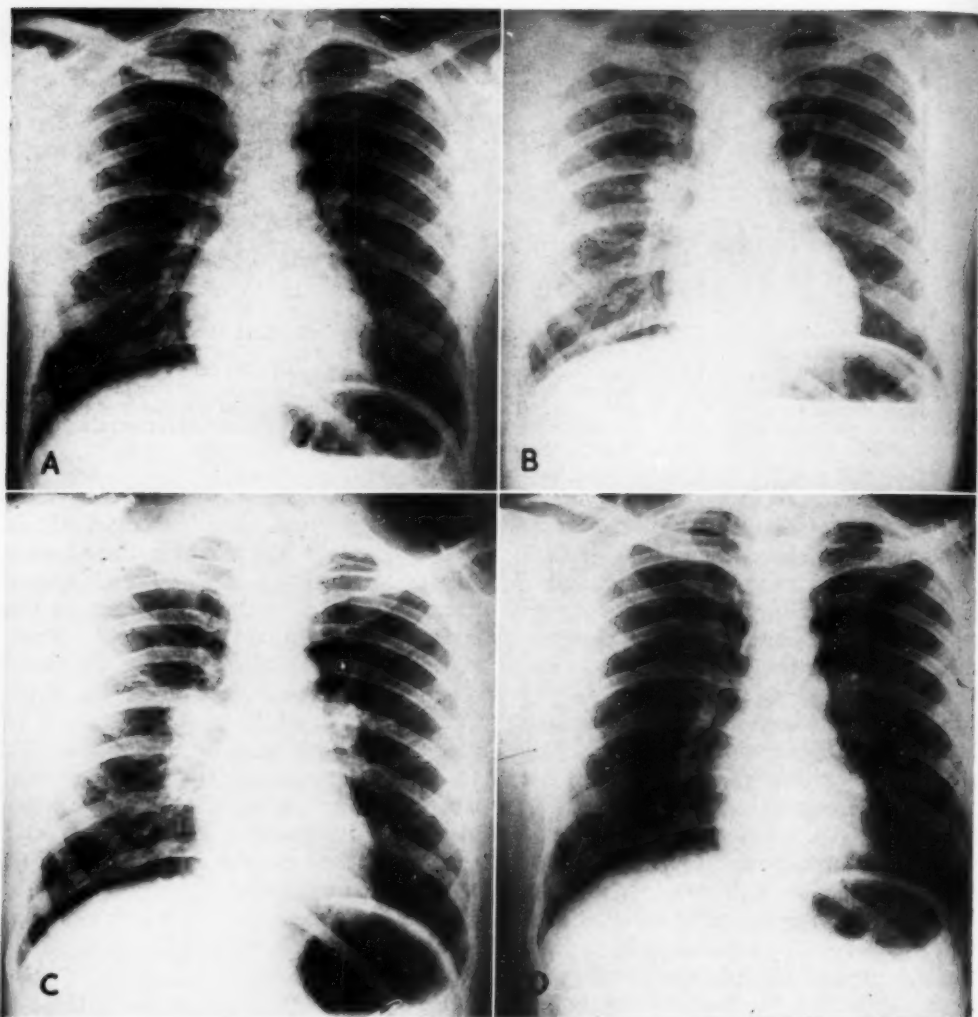


Fig. 14. Asymptomatic lymph node enlargement, probably hyperplastic tuberculosis, in a young, adult male. A. Routine chest film, February 1939, is negative. B. Routine film, January 1940, shows early enlargement of hilum nodes on the right. C. Four months later, at the height of the lymph node enlargement, which now is bilateral. Patient still had no symptoms. D. One year after C, showing return to normal.

never encountered it in hyperplastic tuberculosis.

(d) *Mediastinal lymph node lesions without clinical signs or symptoms:* In a number of instances the type of lymph node lesion described above has been found in supposedly healthy persons on routine roentgen examination of the chest, usually during mass surveys. Follow-up studies have shown the same tendency to a benign

course with gradual resolution over a period of months or years without significant symptoms at any time. Diagnosis in these cases can be only presumptive at first and only by repeated observations can one rule out Hodgkin's disease with certainty. If the peripheral lymph nodes do not become enlarged, as they usually do not, proof may be entirely lacking, since the patient may recover completely. The

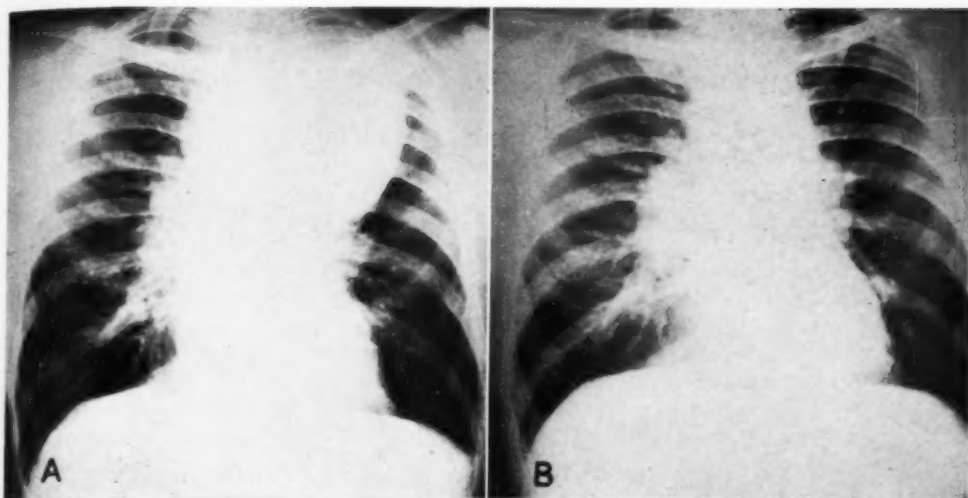


Fig. 15. Hodgkin's disease. White male, age 26, with enlarged nodes in the right axilla and groin. A. Large mediastinal mass of uniform density and smooth borders and a slight nodular thickening of the right hilum. It is impossible to differentiate between the various forms of lymphoblastoma. The diagnosis was made on biopsy of a cervical node. B. Four months later and after roentgen therapy there is considerable improvement. The appearance now closely resembles that seen in hyperplastic tuberculosis (sarcoid). This often is true in Hodgkin's disease during periods of remission following therapy.

degree of involvement may be surprisingly large with a complete absence of symptoms. While pathologic proof of the correctness of the diagnosis may be impossible to obtain, the course of the disease and the roentgen appearance have led us to believe that the lesion is a hyperplastic tuberculosis (Fig. 14). If tuberculin anergy is present, this finding is of significance in the differential diagnosis. Coccidioidomycosis can be ruled out by skin testing with coccidioidin.

Tumors of the Mediastinal Lymph Nodes

Primary Malignant Tumors: Primary malignant tumors of the mediastinal nodes include Hodgkin's disease, lymphosarcoma, lymphatic leukemia, and aleukemic leukemia. Since differentiation seldom can be made with accuracy on roentgen examination, they will be grouped together under the term lymphoblastoma.

Local groups of nodes may be involved (Fig. 6) or the entire collection of mediastinal nodes may be affected. The node or nodes involved produce mass shadows corresponding to their location. The

outer borders are sharp, nodular or lobulated, or in the form of a single large mass having the density of the cardiovascular shadow (Fig. 15). Involvement is usually bilateral but asymmetrical. In advanced cases diffuse widening of the mediastinum to both sides of the mid-line, to or beyond the mid-clavicular line, may be present. Increased density and thickening of the soft tissues of the neck and/or axilla may be visible due to lymph node masses. Infiltration in the pulmonary parenchyma, occasionally with cavity formation, and pleural effusion may be associated.

In *Hodgkin's disease* individual groups of nodes are more frequently involved than the entire mediastinum, and localized nodular thickening is common. The peripheral nodes usually are affected. Symptoms generally are present in proportion to the degree of involvement.

In *lymphosarcoma* there is a tendency to large localized masses, often unilateral or forming a broad mass across the mediastinum, particularly the anterior space. Peripheral node enlargement is not as common as in Hodgkin's disease.



Fig. 16. Metastasis to mediastinal nodes from rhabdomyosarcoma of arm. A. Appearance of the chest before the development of metastases. B. Early metastatic node in the right paratracheal group (arrow). C. Six weeks later. D. Four months later. Continued growth of the original node and metastatic nodules in the lungs.

Lymphatic leukemia simulates Hodgkin's disease roentgenologically and the diagnosis depends on blood examination. *Aleukemic leukemia* shows no variations from the above. Peripheral node enlargement is frequent. The diagnosis depends on histologic examination.

Metastatic Involvement of Lymph Nodes: Isolated metastasis to the lymph nodes without pulmonary involvement is not

common. Occasionally solitary metastatic masses in the nodes will be found (Fig. 16). These may arise from a variety of primary tumors. More frequently lymph node metastases are a part of a generalized lymphogenous spread to the lungs and may be seen with any primary tumor. In these instances the pulmonary and pleural lesions are generally the most prominent feature, consisting of coarse strands radi-

ating outward from the hilum areas; often there are diffuse granular shadows throughout the pulmonary parenchyma, and pleural effusion is common. Localized lymph node metastases can hardly be differentiated from lymphoblastoma solely on the roentgen appearance. In equivocal cases a search for a possible primary tumor should be made and a test of roentgen therapy tried for differential effect. It should be noted that metastases from embryonic tumors of the testicle or kidney may show quite rapid response to such therapy and that an occasional case of lymphosarcoma may fail to respond readily (the reticulum-cell type has been the least sensitive in our experience).

II. PRIMARY TUMORS OF MEDIASTINUM OTHER THAN OF LYMPH NODES

A variety of new growths other than those primary in the lymph nodes may develop in the mediastinum. These may be *benign* (lipoma, fibroma, dermoid cyst and teratoma, chondroma, ganglioneuroma, neurofibroma, cystic hygroma) or *malignant* (fibrosarcoma, neurofibrosarcoma, thymoma, liposarcoma).

The majority of these tumors are extremely uncommon. In the group of benign tumors, the roentgen appearance is that of a single, sharply outlined, round or oval mass. The commonest lesion in this group is probably the *dermoid cyst* or *teratoma*. These tumors form large, well defined masses arising in the anterior mediastinum but usually extending to one side of the mid-line. Thus in two recent cases the tumor protruded into the left lung field in both instances. The mass may be smoothly rounded or oval or its outer margins may be lobulated. Calcification may be present in the wall, and partially or completely formed teeth and irregular bone formation may be seen in overpenetrated films (Figs. 17 and 18). These findings are extremely helpful in diagnosis. When curvilinear shadows of calcification are seen along the margin of a rounded mass, its cystic nature can be surmised, and differentiation lies chiefly between echinococcus cyst and

dermoid. Both may be extremely chronic, slowly growing lesions. Echinococcus disease is rare in persons who have spent their entire lives in the United States. When teeth are present, the diagnosis of dermoid can be made with assurance. When irregular bone formation is seen within the lesion, teratoma is probable, but a bone-forming metastasis from osteogenic sarcoma must be kept in mind. The primary tumor should be obvious. In the upright position, the superior part of the tumor was found by Phemister, *et al* (14) to be more radiolucent than the basal portion, supposedly due to floating of the lighter, fatty contents upon denser fluid beneath.

Dermoid cysts may grow to very large size with practically no symptoms pointing toward their presence, and the disproportion in the size of the tumor and its clinical manifestations would suggest a slowly growing benign neoplasm. If this were in the anterior mediastinum, dermoid would be the most likely diagnosis, while such a tumor located along the posterior mediastinum would, in all probability, be a ganglioneuroma or a neurofibroma. The age of the patient also is an important factor, the majority of dermoids being found in young adults (5).

Ganglioneuroma and Neurofibroma: Ganglioneuromas are said to occur most commonly in the posterior mediastinum along the mediastinal gutter and to form large, rounded mass shadows. The chief factor in differentiation from dermoid cysts is in the location of the tumor. Either may grow to large size with little in the way of clinical signs or symptoms. Neurofibromas may develop from the intercostal nerves and form sharply outlined masses along the borders of the ribs close to the spine. This lesion may develop in a spinal foramen and grow both into the spinal canal and externally. In the thorax such a lesion will form a smooth mass adjacent to the spine; superficial neurofibromatosis or *café au lait* spots may be present. With this "dumb-bell" type of tumor, erosion of the pedicles and/or vertebral bodies adjacent will give the clue to the proper diagnosis

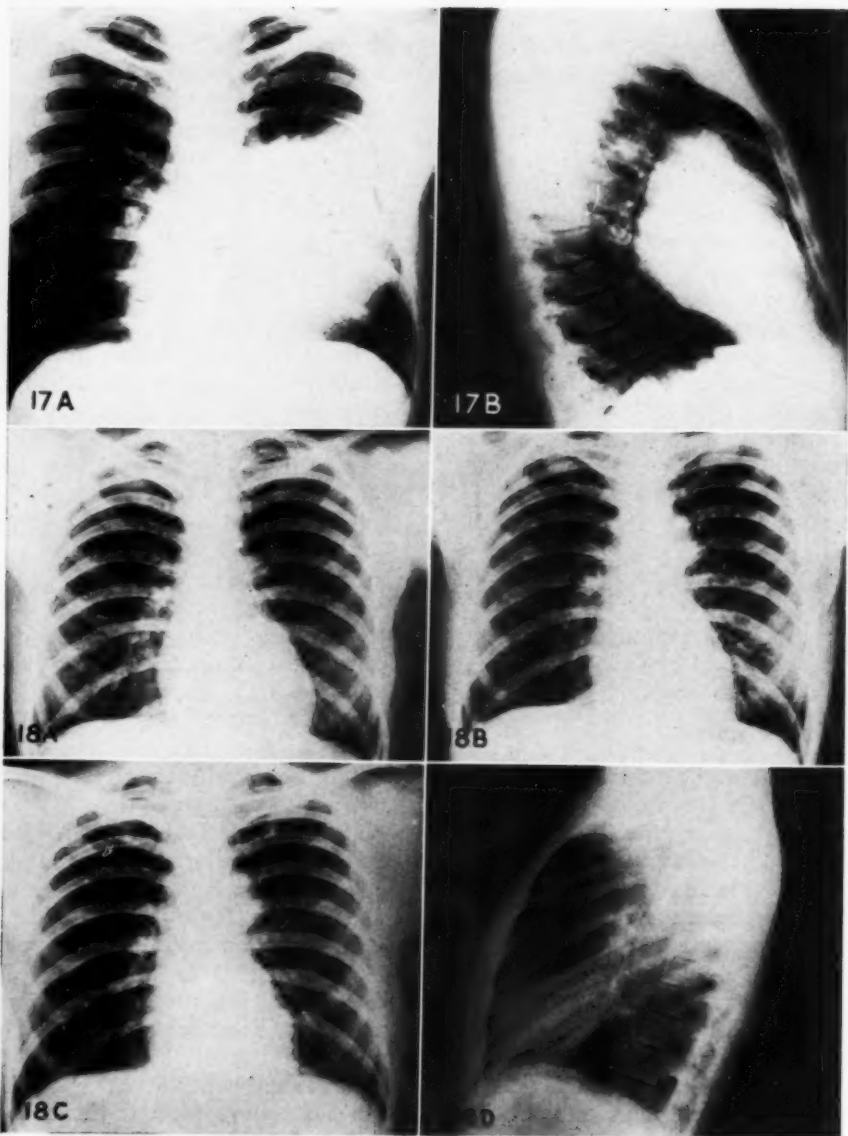


Fig. 17. Dermoid cyst of the mediastinum. White male, age 29. X-ray examination of the chest during an acute respiratory infection revealed a mass in the left side. A. Frontal view. B. Lateral view, demonstrating the anterior location and showing plaques of calcification along the borders of the tumor. The location, the relative lack of symptoms in spite of the large size of the tumor, and the calcification along the margins make the diagnosis of dermoid almost certain. The tumor was removed successfully.

Fig. 18. Dermoid cyst of the mediastinum. White female, age 22. A. Routine chest film taken during nurse's training course. Arrow points to a small mass overlying the pulmonary artery. B. Four years later. The mass has grown slowly but has caused no symptoms. C. One year after B. Slight further growth. D. Lateral view localized the mass in the anterior mediastinum. The tumor was removed successfully. (The films for A and B were loaned through the courtesy of Dr. L. V. Littig of Madison, Wis.)

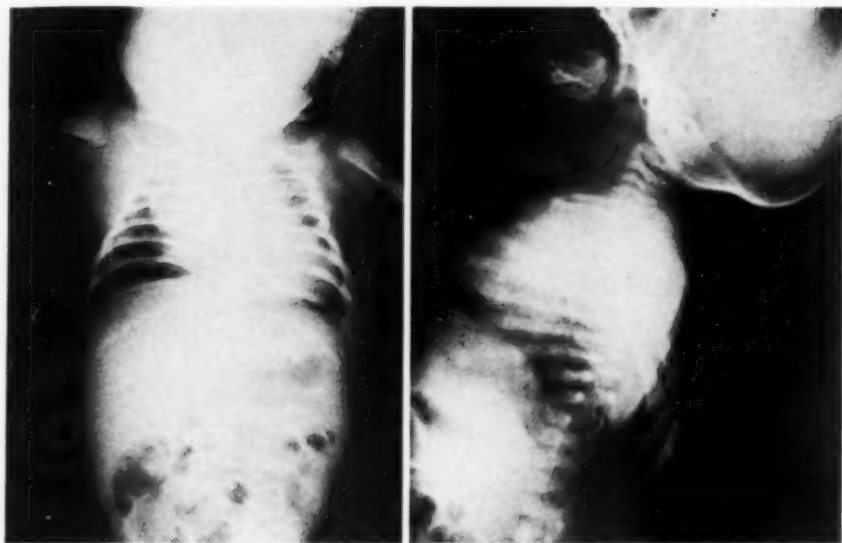


Fig. 19. Cystic hygroma of the neck, axilla, and mediastinum. The patient died as a result of respiratory obstruction. Autopsy.

and serve to emphasize the need for examination of the spine when abnormal areas of density are found in the posterior mediastinum.

Cystic Hygroma: This is a congenital malformation involving the lymphatic vessels of the neck, with the formation of slowly growing multilocular cysts. The tumor may extend into the mediastinum and be confused with lymphoblastoma (Fig. 19). The diagnosis usually is possible on clinical examination and depends on the history of a mass present at birth or appearing shortly thereafter with subsequent slow growth and a cystic feel to palpation. There is nothing characteristic in the roentgen appearance, though in several instances we have noted on fluoroscopic examination a distinct narrowing and change in contour of the mediastinal mass on deep inspiration, suggesting the soft, cystic nature of the lesion.

Fibrosarcoma, Neurofibrosarcoma, and Thymoma: Fibrosarcoma of the mediastinum must be rare and we know of no identifying characteristics in the roentgenogram. Neurofibrosarcoma can be diagnosed as such only when, in addition to the

evidence of neurofibroma as described above, there is evidence of metastatic tumor formation in the lungs or elsewhere. Thymoma will be discussed under the section on diseases of the thymus. Cases of liposarcoma have been reported, but there is nothing characteristic in their appearance as far as we have been able to determine.

III. MEDIASTITIS

Acute Mediastinitis

General Considerations: Acute infections of the mediastinum, exclusive of those limited to the lymph nodes, are due in the main to a relatively few causes. Among these, esophageal injuries and lesions and the extension of infection from suppurating lymph nodes and from infections in the retropharyngeal and retro-laryngeal areas form the largest group. Less common causes are extension of infection from below the diaphragm or from injuries to or infections of the sternum and anterior chest wall, infections of the spine, hematogenous spread from some distant focus, and infections originating in the anterior part of the neck. It is obvious, therefore, that in most cases of acute medi-

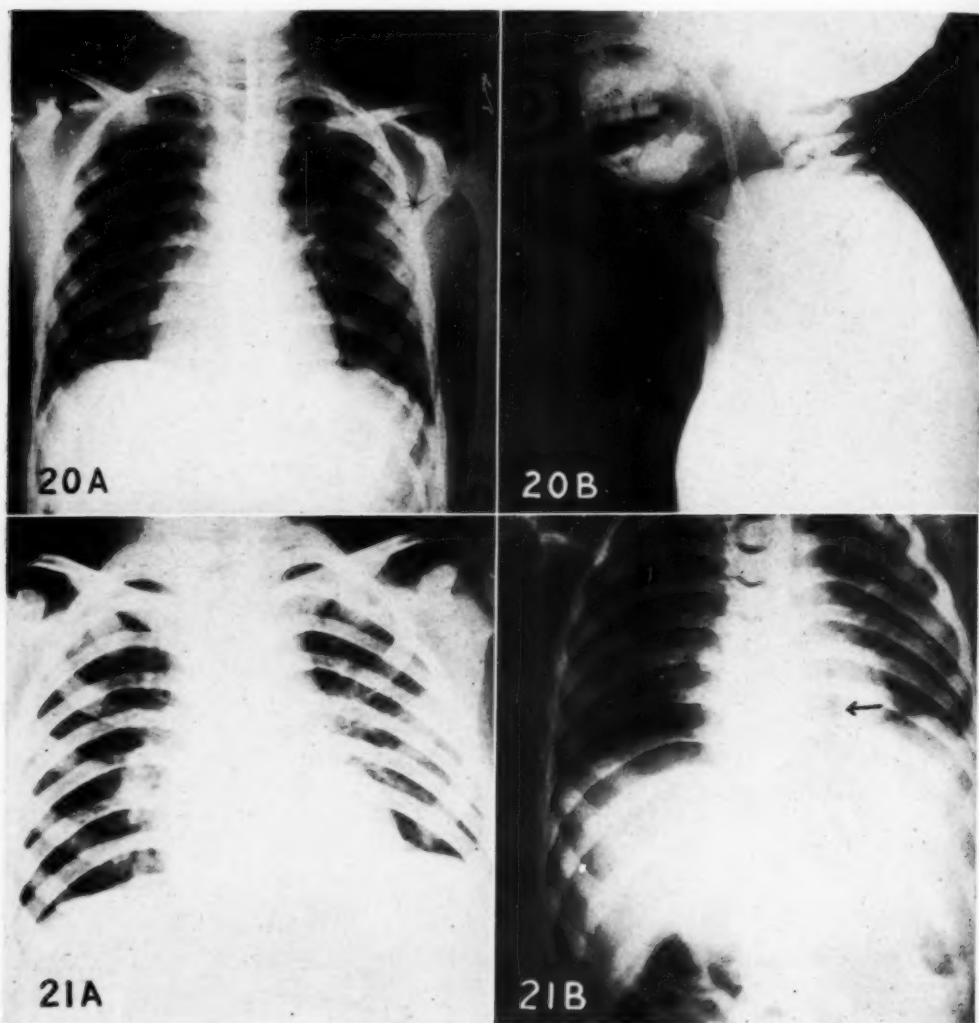


Fig. 20. Acute mediastinal abscess following thumb tack injury to pharynx. The infection began in the retropharyngeal tissues and extended downward into the posterior superior mediastinum. A. Frontal view, showing only a slight widening of the upper mediastinal shadow. B. Lateral view, showing the location and extent of the abscess much better. The rubber tube is in the esophagus. Autopsy.

Fig. 21. Acute diffuse mediastinitis following injury to lower esophagus during attempted dilatation of a stricture. A. Frontal view with ordinary technic is not diagnostic for mediastinal abnormality. B. Overpenetrated film shows air in the mediastinum (arrow) and generalized, diffuse density throughout the lower mediastinum. Recovery without open drainage.

astinitis the lesion will be in and largely confined to the posterior mediastinum.

Acute Diffuse Mediastinitis and Mediastinal Abscess: It is probable that most cases begin as a diffuse infection of the mediastinal tissues. In some it remains as such and then may be called a diffuse or phlegmon-

ous mediastinitis. In others the infection soon becomes localized, with abscess formation, and the process is then known as acute mediastinal abscess. Since these two types are so closely related they will be discussed together. The roentgen appearances differ somewhat depending upon

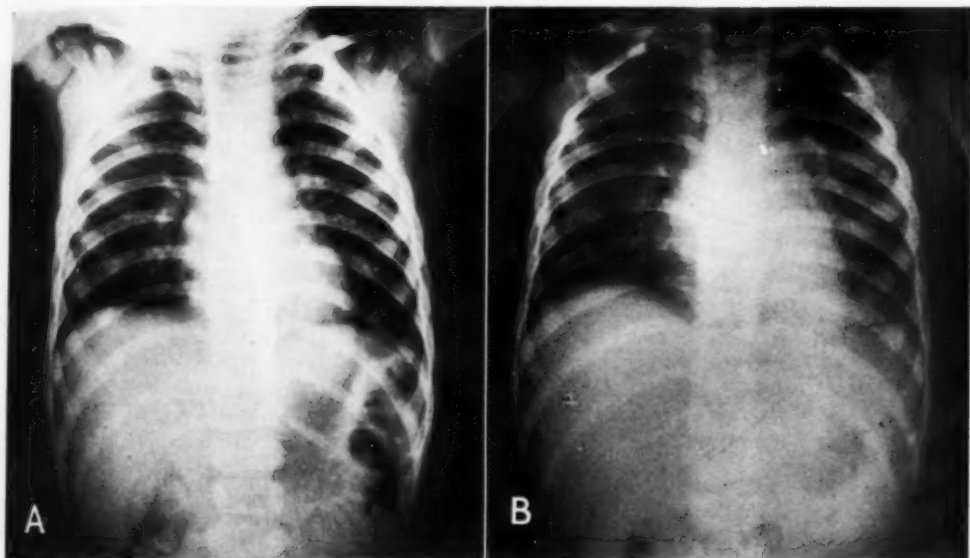


Fig. 22. Acute diffuse mediastinitis following injury to the lower esophagus during instrumentation. A. Chest film before instrumentation. B. Three days after dilatation of stricture, which was followed by clinical signs of infection. There are cloudy density throughout the lower mediastinum and a mild pleural reaction with fluid on the left side.

the cause. In those mediastinal infections which begin as retropharyngeal or retrolaryngeal abscesses and later extend into the mediastinum, the earliest changes will be detected in lateral films of the neck. These will show the findings commonly associated with such abscess, widening of the retropharyngeal and retrolaryngeal soft tissue shadow, forward displacement of the upper end of the trachea and, often, a reversal of the cervical curve of the spine. If the infection extends downward, the shadow in the posterior mediastinum is simply a continuation of that in the neck, the displacement of the trachea anteriorly becoming more pronounced (Fig. 20). In the antero-posterior view a moderate broadening of the supracardiac shadow will be seen, but this may be so slight that it may not be recognized and more importance may be attached to the lateral view. Also, in those cases due to injuries to the upper end of the esophagus, the early roentgen changes are best seen in lateral views of the neck. In injuries lower down in the esophagus the first evidence of a developing mediastinitis is a diffuse in-

crease in density of the mediastinum. This is best brought out in slightly overexposed films when the hazy clouding can be seen overlying the heart shadow and extending to both sides of the mid-line. The area of opacity has no sharp outer limits. Pleural reaction on one or both sides may be present relatively early, in the form of slight amounts of fluid, and pneumothorax similarly may be found (Figs. 21, 22). In the presence of diffuse infection, little if any deviation of the trachea or esophagus will be seen.

The process may undergo a slow, gradual clearing, and the patient recover without drainage, or death may follow without a distinct abscess being present. Much depends upon the degree of injury and the virulence of the infecting organisms. In other cases, after passing through the diffuse stage, the infection becomes localized with abscess formation. When this occurs the density becomes more sharply defined and displacement of the esophagus and/or trachea away from the abscess is apparent. The abscess assumes a mass contour and may simulate a tumor. The shadow may

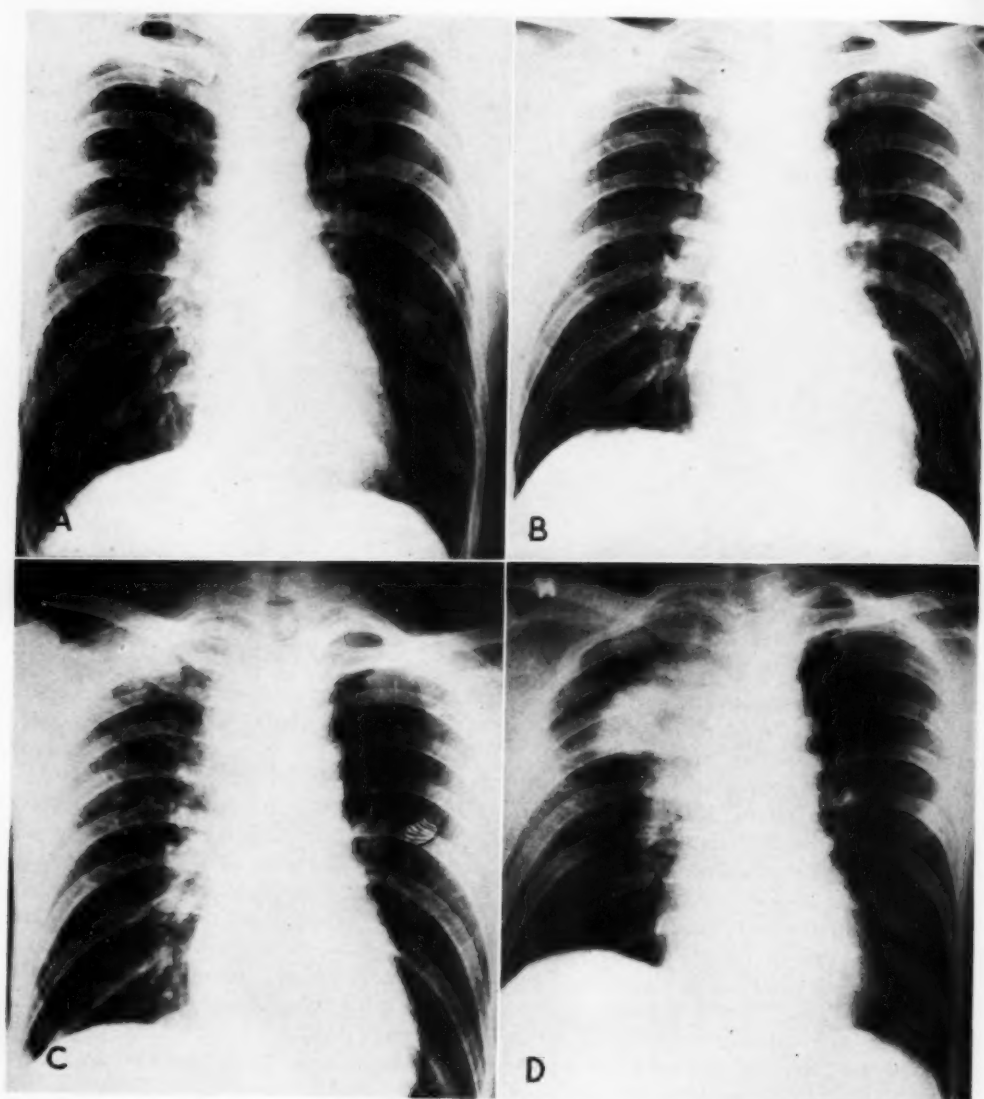


Fig. 23. Mediastinal abscess, probably secondary to infection and suppuration of the mediastinal lymph nodes with extension to the lung; bronchial drainage and cure without surgical intervention. A. Appearance of the chest before the onset of the mediastinal infection. B. Beginning widening of the upper mediastinal shadow. C. Five days after B. D. Six days after C. The infection has extended to the right upper lobe.

be rounded or oval or may be an elongated mass in or along a mediastinal border. If the patient is first seen in this stage, diagnosis may depend on a history of a previous lesion sufficient to cause mediastinitis plus the clinical signs and symptoms of mediastinal infection.

A particular form of acute mediastinal

abscess deserving special mention is that due to *suppuration of lymph nodes* in the mediastinum. The cause of such suppuration may be an infection in the throat, the lungs, or the pleura. Often the primary infection is masked by the symptoms of the developing mediastinitis or it may have been so mild as to be virtually un-

noticed. Observation of such cases during their development shows, first, a slight generalized widening of the supracardiac shadow, which may be bilateral or unilateral. The opacity rapidly increases in width to form a dense shadow in and adjacent to the mediastinum. Not uncommonly there is direct extension to the lung, and spontaneous drainage may occur through rupture into a bronchus. If first seen at this stage the lesion may be diagnosed as a lung abscess, since the mediastinal involvement may be obscured by the pulmonary reaction (Fig. 23). If a fluid level is present within the abscess cavity, it may extend into the mediastinal area and indicate that the abscess is at least in part mediastinal rather than wholly pulmonary. Similar invasion of the lung with bronchial drainage has been seen with mediastinal abscess due to esophageal perforation as a result of injury or carcinoma.

Chronic Mediastinitis

General Considerations: Chronic infections may be due to tuberculosis, syphilis, actinomycosis, or pyogenic infection. The roentgen diagnosis is at times difficult. If there are associated lesions in the lungs, aorta, heart, or pericardium, they serve as a clue to the etiology of the mediastinal involvement. The clinical signs and symptoms are of great importance in diagnosis, and correlation with the roentgen findings is essential. If the infection is localized and involves the region of the great vessels, such as the superior vena cava, alarming symptoms of vena caval obstruction may be present with relatively minor roentgen changes.

Chronic Mediastinal Abscess: The majority of chronic mediastinal abscesses are due to tuberculosis, either arising from a lesion in the sternum or spine or from tuberculosis of the mediastinal lymph nodes. In those cases arising from bone, roentgen evidence of the original bone lesion usually is obtained. Paraspinal abscess due to tuberculosis of the dorsal spine can be considered a form of chronic mediastinal abscess since it bulges into the mediasti-

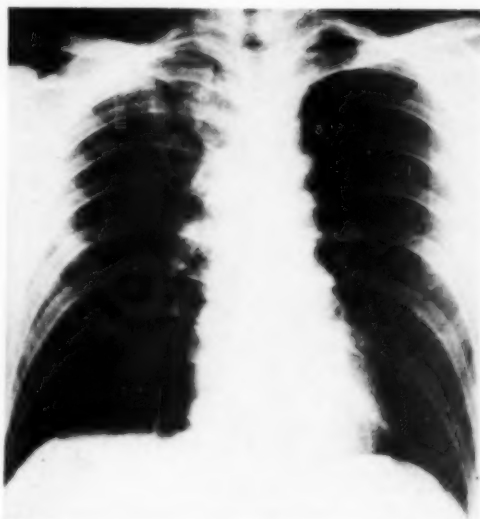


Fig. 23E. Roentgenogram taken one month after D. The abscess evacuated spontaneously into a bronchus and a cavity now is seen. Following this there was a gradual decrease in the size of the cavity and the lesion healed, leaving only a few fibrous strands.

num. This is the most frequent cause of such abscesses. It is discussed more fully under the heading Diseases of the Spine. Widespread invasion of the mediastinum may develop from such a focus, but usually it remains limited to the posterior space (Fig. 31). When a tuberculous abscess is secondary to suppuration of lymph nodes, differentiation from other causes is more difficult. Pulmonary tuberculosis may be demonstrable or the nodes may contain calcium. Other causes are actinomycosis and pyogenic infections of the spine or lymph nodes. Acute pyogenic abscess may subside into a chronic course and become a chronic abscess (Fig. 24).

Roentgenographically chronic mediastinal abscess appears as a mass shadow, usually quite well demarcated, most commonly in the posterior mediastinum. In the absence of associated lesions in the lungs or bones, diagnosis may be impossible on roentgen examination alone. In those cases due to actinomycosis, lesions in the lungs, pleura, or chest wall are almost invariably present and tend to obscure the mediastinal process.

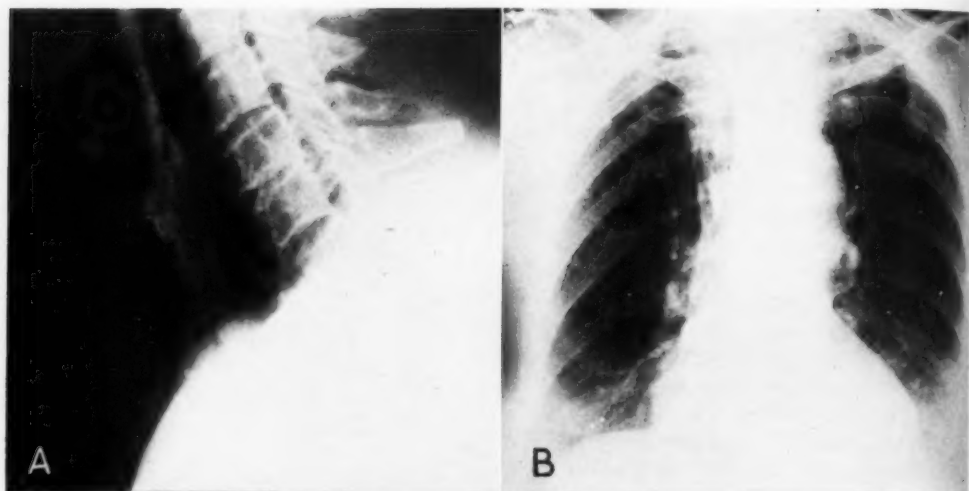


Fig. 24 A and B. Chronic mediastinal abscess following a chicken bone injury to the upper esophagus. A. Lateral view of the neck, showing extensive cervical emphysema as a result of perforation of the upper wall of the esophagus. B. Frontal view of the chest made at the same time as A. Widening of the upper mediastinal shadow, with mediastinal emphysema on the right.

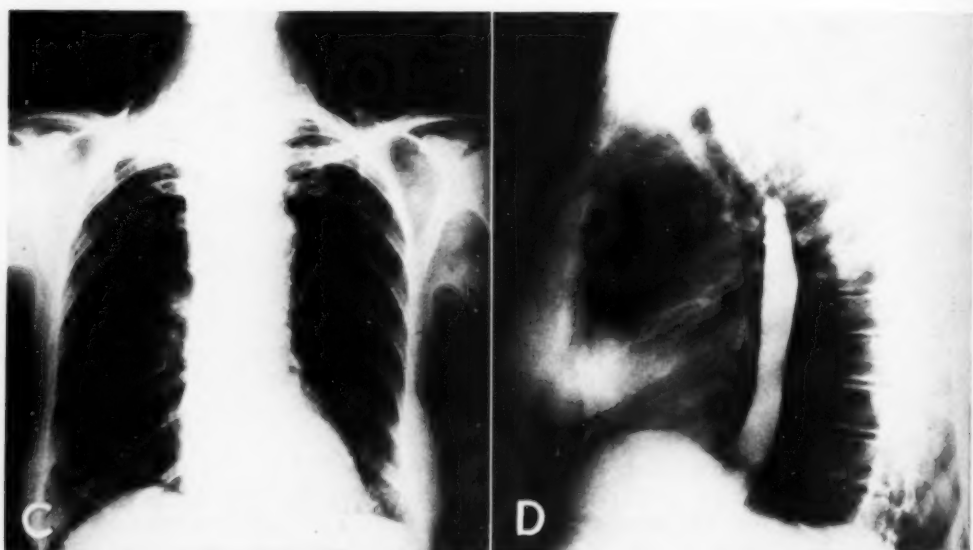


Fig. 24 C and D. C. Four months after 24B a slight widening of the mediastinum persists. D. A lateral view demonstrates a soft tissue mass behind the esophagus and small collections of barium within the mass due to a fistula communicating with the proximal end of the esophagus. This is an example of an acute infection subsiding into a chronic abscess.

Chronic Diffuse Mediastinitis or Fibrous Mediastinitis: Chronic diffuse or fibrous mediastinitis may represent an active chronic infection or be only the residue of previous infection. It may be due to tuber-

culosis, syphilis, or pyogenic organisms. There often is an associated chronic pericarditis with adherent pericardium (mediastinopericarditis) and with the clinical picture of congestive heart failure. The

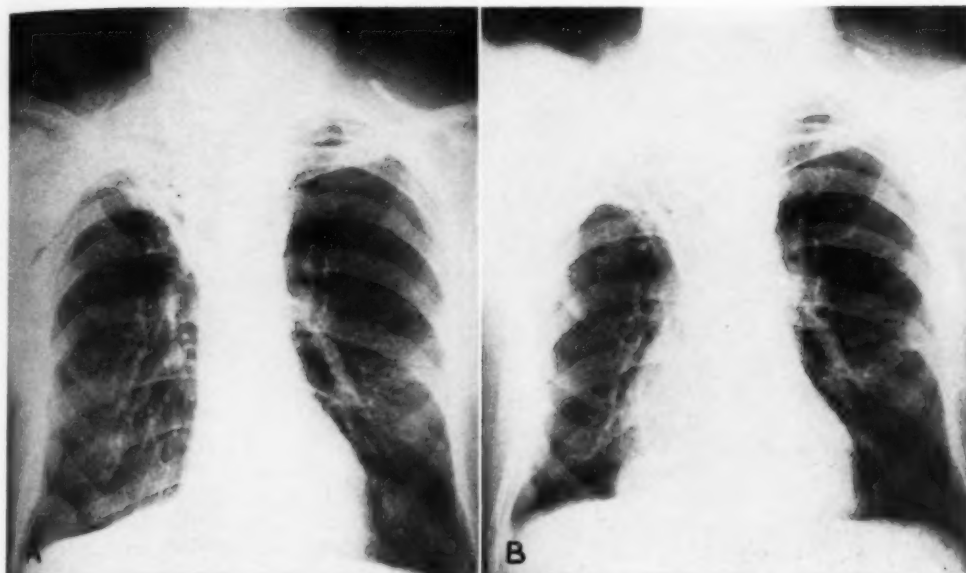


Fig. 25. Paramediastinal effusion in association with tuberculosis. A. Frontal view of the chest before the development of the fluid. B. Convex density appeared along the medial posterior mediastinal gutter after a first stage thoracoplasty. On aspiration clear fluid was obtained and the density gradually resolved.

mediastinal space or spaces involved are denser than normal but the density is seldom sharply defined, and localized mass shadows are rarely present. The outer margins of the central shadow, including that formed by the cardiac borders, may be fuzzy; adhesions between the heart and sternum may be present, and the other roentgen signs of adherent pericardium may be elicited, including absent or diminished cardiac pulsations, small sized heart in the presence of a clinical picture of congestive heart failure, and calcification in the pericardium. The esophagus may show irregularities in contour due to adjacent fibrosis.

In summary, therefore, chronic fibrous mediastinitis produces a general increase in density of the mediastinum; loss of the normal differentiation of mediastinal structures; general or localized widening of the central shadow with fuzzy outer margins; possible evidences of chronic pericarditis with adherent pericardium; associated syphilitic lesions in the heart or aorta, or evidence of parenchymal pulmonary tuberculosis; associated lesions of the lungs,

pleura, or bony thorax suggesting actinomycosis.

Mediastinopleural (Paramediastinal) Effusion

Extension of fluid into the pleural space adjacent to the mediastinum is not uncommon in free pleural effusions. The fluid forms a dense, triangular opacity overlying the cardiac border with the base on the diaphragm or merging with a fluid density in the basal pleural space. If the fluid is not encapsulated—and it frequently is not—the shadow will shift with change in position of the patient. The form of the shadow may be similar to that of a contracted, atelectatic lower lobe or accessory lobe. The presence of fluid elsewhere in the pleural cavity, the unilateral nature of the lesion, and the shifting density ordinarily will serve for differentiation from other conditions. If the diagnosis is in doubt, diagnostic aspiration is recommended.

Encapsulated pyogenic empyema may develop in this location, in which event the shadow shows a bulging, convex outer

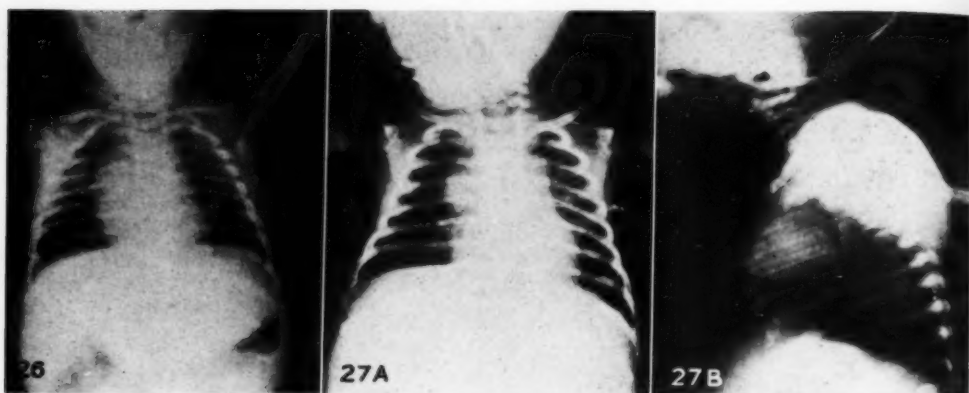


Fig. 26. Enlarged thymus. Note the sharp delineation of the right lobe, inferiorly.

Fig. 27. Enlarged thymus in a newborn infant, discovered accidentally on a routine chest examination. A. Frontal view. B. Lateral view, localizing the density to the anterior mediastinum.

border rather than a triangular contour. Broadly speaking, such a lesion can be considered as a form of mediastinal abscess, although it is, in the strictest sense, a type of pleural empyema. A history or signs of a preceding pneumonia may be obtained. In chronic pulmonary tuberculosis, local encapsulation of fluid may develop in the mediastinal pleural space, again producing sharply outlined convex or rounded shadows along the mediastinal border. Differentiation from neoplasm depends on the location of the density, generally along the lower posterior mediastinal gutter, the presence of pulmonary tuberculous lesions, the results of diagnostic aspiration, or the decrease or disappearance of the shadow over a relatively short period of observation. In our experience the occurrence of loculated pockets of fluid is not uncommon in pulmonary tuberculosis and in the presence of such pulmonary lesions, even though fibrotic or minimal, such paramediastinal opacities are considered as fluid until proved otherwise (Fig. 25).

Mediastinal Emphysema

Air in the mediastinal tissues is frequently due to extension of emphysema in the neck and is seen most commonly after injuries to the pharynx, trachea, and esophagus. Extension of air into the mediastinum from the pleural cavity after

pneumothorax occurs but rarely, and similarly spontaneous mediastinal emphysema has been reported infrequently (11, 20). The amount of air generally is small, forming streaky, radiolucent areas parallel to the long axis of the body within the mediastinum or along its borders. These are more readily seen when present in the superior space (Fig. 24) and may be continuous with similar air shadows in the neck. Small amounts of air can readily escape detection in routine study, and overexposed roentgenograms are helpful (Fig. 21).

IV. DISEASES OF THE THYMUS AND THYROID

The Thymus

Thymic Hyperplasia: Simple hyperplasia of the thymus may be found in infancy. Most commonly seen during the first six months of life, it decreases rapidly in incidence until, after the age of two, it is rare. A great deal of confusion and disagreement exist as to the significance of this condition. Some of this is due to a failure of recognition that frequency of occurrence need not indicate an associated frequency of clinical symptoms. It is our opinion that mild to moderate degrees of thymic hyperplasia are fairly common in infants, but we do not believe that, in the majority of instances, treatment is necessary or desirable. Error in

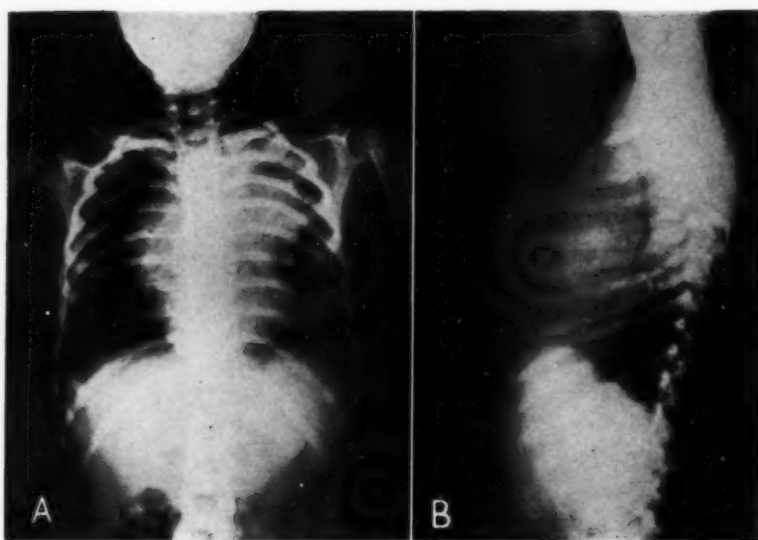


Fig. 28. Thymoma. A. Frontal view. B. Lateral view. The mass is confined to the anterior mediastinum and is compressing the trachea.

diagnosis may occur when the examination is limited to a single film of the chest. In the majority of instances a normal gland can be identified as such by routine antero-posterior and lateral views of the chest and neck. Gross enlargement of the gland may also be recognized. In most cases, and especially when there are borderline variations, we have found fluoroscopy invaluable. The normal supracardiac shadow in infants does not differ greatly from that in adults when the films are made at the end of inspiration. At the end of expiration, normally, the shadow becomes wider, but even this widening is rather slight in the average child. The normal thymus gland in an infant is a small structure. There is some difference of opinion as to what its weight should be at different age periods. Hammar found it to be 12 gm. at birth, 23 gm. at five years, and 35.5 gm. at puberty. There is general agreement that the thymus reaches its largest size at the time of puberty and then diminishes rapidly; also, that the increase in size of the thymus does not keep pace with body growth, since the normal infant triples its weight in one year (19).

If there is thymic hyperplasia to any

appreciable degree, widening of the supracardiac shadow is present and persistent during the entire respiratory cycle. The abnormal density is present in the anterior superior mediastinum. The thymus often can be visualized as a broad columnar or ovoid shadow in this region extending down and overlapping the cardiac borders. If observation is carried out throughout the respiratory cycle and with varying degrees of rotation of the patient, the lower margin of one or both lobes frequently can be identified as a distinct notch even when the enlargement is relatively small (Figs. 26, 27). When such widening is present, and particularly when the inferior border of the lobe or lobes can be seen, one is justified in considering it as evidence of thymic enlargement, since in the majority of normal infants, such shadows are not seen. Whether one wants to consider such hyperplasia of significance or not is another question and beyond the scope of this discussion. The differential diagnosis includes lymphoblastoma and tuberculous adenitis. Since thymic hyperplasia is searched for and encountered chiefly in the first six months of life, there usually is little difficulty. Beyond the age of two it is our im-

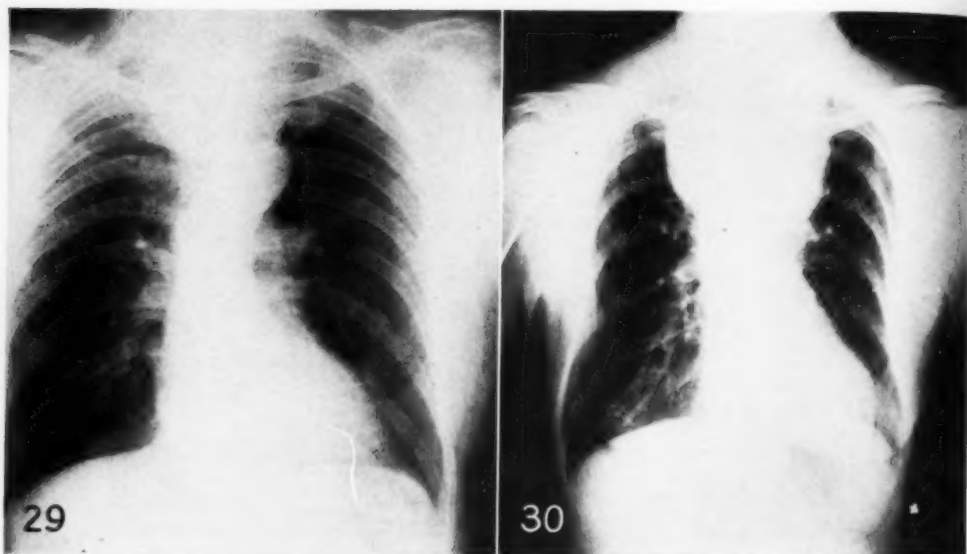


Fig. 29. Enlarged thyroid with moderate substernal extension.
Fig. 30. Enlarged thyroid with a large intrathoracic portion.

pression that simple hyperplasia seldom is found and an abnormal superior mediastinal mass is in all probability due to some other cause. Tuberculous nodes may be a source of confusion but are more likely to be nodular with fuzzy outer borders and seldom confined entirely to the anterior mediastinum, with the hilum and paratracheal groups usually involved.

Persistent Thymus in Adults: A persistent thymus is occasionally encountered in an adult at necropsy. The amount of such thymic tissue is small and we have never been able to find any suggestion of abnormal density due to such cause even when reviewing roentgenograms after the autopsy findings were known. It is believed, therefore, that persistent thymus in the adult or older child is not possible of roentgen diagnosis.

Thymic Tumors: The only tumor of significance arising from the thymus is the *thymoma*. This tumor usually belongs in the lymphosarcoma group, although some pathologists believe it to be a distinct entity. Influenced by our colleagues in the Department of Pathology, we make no particular attempt to differentiate thy-

omas from lymphosarcomas, preferring to use the term lymphosarcoma to include those tumors apparently arising from the lymphoid elements of the thymus as well as those arising from the mediastinal lymph nodes (Fig. 28). From the standpoint of clinical roentgen practice this is entirely satisfactory both from the diagnostic and therapeutic aspects. A few thymic tumors appear to be of carcinomatous nature histologically but they cannot be recognized as such on roentgen examination.

The Thyroid

Suprasternal Enlargement of the Thyroid: Enlargement of the thyroid gland often causes a rounded shadow obscuring the medial aspect of the lung apices. The borders are seldom clearly defined, displacement and compression of the trachea are often present, and calcified shadows within the mass are frequent. The nature of the opacity can be recognized by these means and confirmed by palpation of the neck.

Substernal Extension of the Thyroid: Extension of the thyroid substernally is not uncommon and varies in degree.

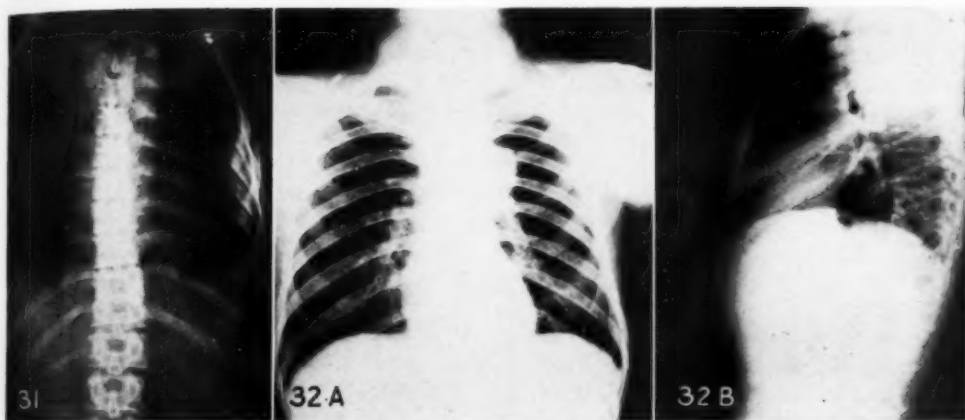


Fig. 31. Tuberculous abscess arising from the spine. The abscess has burrowed up and down the posterior mediastinum, forming a broad columnar shadow instead of the fusiform density commonly seen in such abscesses.

Fig. 32. Tuberculous mediastinitis from tuberculosis of the dorsal spine. A. Frontal view of the chest, showing a mass of indeterminate character in the left hilum area. B. Lateral view, showing the mass to be in the posterior mediastinum behind the trachea. Films of the spine revealed an intervertebral type of tuberculosis with a paraspinal abscess shadow continuous with the density seen in A. The patient died several months later of miliary tuberculosis.

Minor degrees of extension are frequent and the shadow produced is simply a continuation of the thyroid shadow in the neck below the level of the upper border of the sternum (Fig. 29). The borders of the substernal extension become more distinct due to the contrast afforded by the adjacent lungs, rounding off below, at or above the level of the aortic arch. The lower margin generally is lost in the density of the mediastinal shadow. The extension frequently is more pronounced on one side and may be entirely unilateral. Fluoroscopic observation during the swallowing act will show the shadow to move upward with the larynx and, since there is an associated enlargement of the thyroid in the neck in most instances, palpation at the same time will demonstrate the continuity of the shadow with that of the palpable portion. In the lateral view, the mass is seen in the anterior superior mediastinum and tracheal deviation to one side or the other and posteriorly is the rule. Malignant change in a substernal or intrathoracic thyroid offers no identifying characteristics locally, but distant metastases may give a clue as to the malignant nature of the lesion. In exceptional instances the

main mass of the enlarged gland is within the thoracic cavity (Fig. 30).

V. DISEASES OF THE SPINE

Tuberculosis and other Infections: Abscess formation due to tuberculosis of the spine is a common cause for abnormal shadows in the mediastinum. In frontal films of the chest the lesion may simulate tumor formation or an aneurysm of the aorta. Films of the spine usually reveal evidences of tuberculous caries of one or more vertebral bodies. At times only narrowing of an intervertebral disc may be seen. The shadow of the abscess usually is fusiform and generally quite symmetrical, although unilateral abscesses do occur. The paraspinal soft tissues in the thoracic area normally appear as a thin band of density paralleling the vertebral borders, best seen on the left side. The abscess shadow is always continuous with this paraspinal shadow, which widens gradually above and below and merges with the abscess. The nature of such an opacity can be recognized as being paraspinal in location even though there are no visible changes in the vertebral bodies or discs. Granular calcification may be present

within the abscess if it is of long duration. Occasionally the abscess burrows up and down the spine, forming a broad columnar shadow (Fig. 31). A tuberculous abscess of the spine may invade or rupture into the mediastinal tissue causing a true tuberculous mediastinitis (Fig. 32). Pyogenic and fungus infections may cause similar abscesses but are of infrequent occurrence.

Tumors of the Spine: Tumors arising from or involving the vertebrae seldom cause any appreciable soft tissue density that might be confused with other masses. When such a shadow is present, the bone changes will indicate that the lesion is of bony rather than of mediastinal origin. Tumors of the spinal nerve sheaths (neurofibromata) have been discussed above (page 25).

VI. CARDIAC AND VASCULAR LESIONS

Enlarged Left Auricle: In mitral valve disease the left auricle may enlarge considerably and protrude beyond the right heart border, forming a dense mass through which the right cardiac margin can be seen, or forming a double silhouette along this border. A mitral configuration of the cardiac shadow and prominence of the pulmonary vascular markings in the hila are to be expected. In the lateral view the posterior mediastinum is encroached upon and its space may be obliterated and barium filling of the esophagus will show it to be displaced posteriorly in its distal portion. This lesion should be recognized readily if one remembers that the left auricle usually bulges toward the right side when it enlarges, rather than to the left. The other evidences of mitral valve disease will be apparent (Fig. 33).

Aneurysm of the Aorta: Aortic aneurysm belongs properly under diseases of the cardiovascular system, and mention of it will be made here only because of the frequent confusion of aneurysm and mediastinal tumor. In the majority of cases differentiation can be made without difficulty if all factors, including the clinical, are taken into consideration. The diagnosis depends upon the following: (1)

mass continuous with the aortic shadow, from which it cannot be separated by rotation of the patient; (2) expansile type of pulsation on fluoroscopy or kymography; (3) calcification in the wall of the aneurysm continuous with calcification in the aortic wall; (4) smooth pressure type of erosion of the sternum or the spine, depending on the location (Fig. 34); (5) displacement of the esophagus dorsally and to the right in aneurysms of the arch and anteriorly and to either side in aneurysm of the descending aorta; (6) clinical evidences of syphilis; (7) positive serology or spinal fluid. Of all these, the only one which is present constantly is the first. In some cases diagnosis may be extremely difficult. Pleural effusion or massive atelectasis due to pressure on a major bronchus may suggest neoplasm, and the aneurysm may even be hidden by these changes. Generally, when searching for aneurysm or when considering it in differential diagnosis, films made with the Potter-Bucky diaphragm will be found useful. Calcification may be demonstrated more readily, and continuity with the aorta can be seen more easily. Kymography will be of some aid in these cases but cannot be relied upon to the exclusion of other data, since a kymogram is only a record of cardiovascular motion. If the diagnosis is still impossible after all methods of examination have failed, a test of radiation therapy in small doses may be tried. Contrast visualization of the aorta after the method of Robb and Steinberg (17) should prove a valuable procedure in the diagnosis of aneurysm and its differentiation from other mediastinal masses.

Right-Sided Aorta: Development of the aortic arch on the right side may occur as a congenital defect. When there is no associated dextrocardia, this lesion may cause an abnormality in the mediastinum which may at first be confusing. The typical roentgen findings consist of absence of the normal aortic knob on the left and a corresponding bulge to the right, displacement of the trachea anteriorly and to the left, and displacement of the esopha-

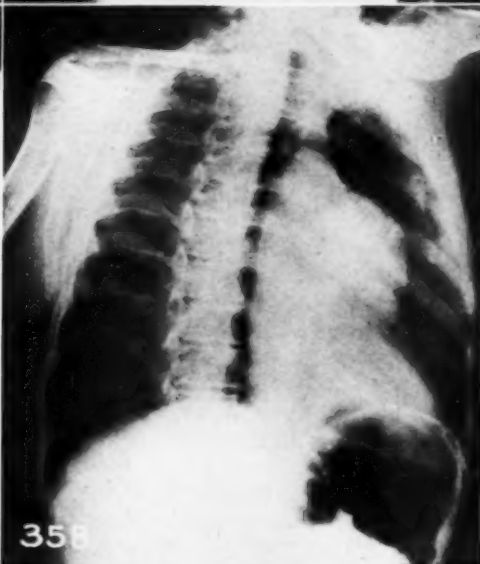
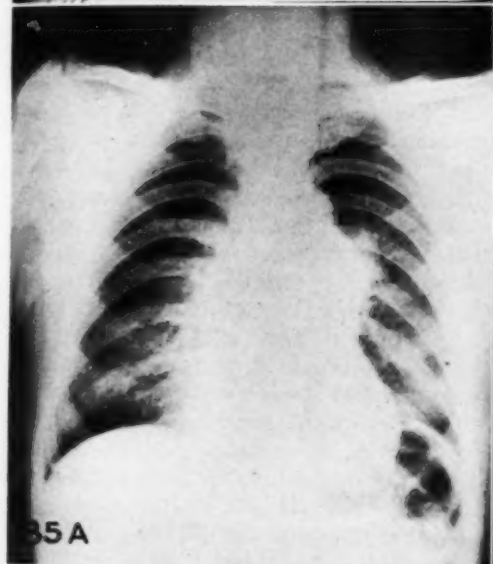
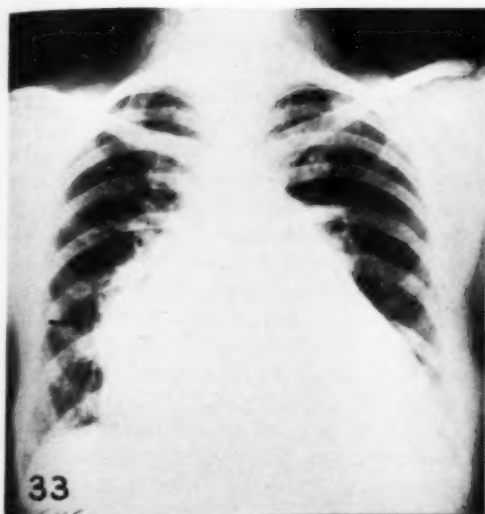


Fig. 33. Enlarged left auricle in mitral valve disease forming a part of the right heart border (arrow).

Fig. 34. Typical pressure type of erosion of the dorsal vertebrae due to a saccular aneurysm of the descending thoracic aorta.

Fig. 35. A. Congenital aneurysmal dilatation of the pulmonary artery. B. Left anterior oblique view.

gus in the same direction, so that it passes to the left of the aortic shadow when viewed from in front and anteriorly to it when viewed from the side. The impression on the esophagus produced by the aortic arch, therefore, is on its right and posterior borders rather than on the left and anterior, as is the case in the normal.

The diagnosis can be established without difficulty if the position and course of the esophagus in relation to the aorta are determined.

Pulmonary Artery Dilatation: Dilatation or congenital aneurysm of the pulmonary artery may be found as a part of a congenital cardiovascular defect. There usually

is an associated interatrial septal defect, according to Roesler (18). The dilated artery forms a smooth ovoid or rounded mass along the left cardiac margin below the aortic arch (Fig. 35). The larger branches also are increased in size and may cause dense rounded masses in the hila.

On fluoroscopy the vascular nature of these shadows can be recognized by their pronounced pulsation, but on the film they may suggest enlarged lymph nodes. There also is the possibility of diagnosing aneurysm of the pulmonary artery when the shadows actually are due to enlarged nodes. On the left side masses of nodes may form a smooth density which mimics a dilated artery very closely, even to an apparent expansile pulsation. If this is the only mass present, one should be able to recognize its glandular nature since, if the main pulmonary artery is dilated, there should be some dilatation of its branches visible in the hilum areas and accentuated vascular pulmonary trunks as well. Unless these associated findings are present, a diagnosis of aneurysm of the pulmonary artery based solely on a pulsating mass in this region should be made with caution.

Aneurysm of the Innominate Artery: This forms a semicircular mass in the right anterior superior mediastinum continuous below with the aorta. The trachea is deviated to the left and posteriorly. Evidence of aortitis is invariably present and, according to Warfield, is a most significant feature (21). The lesion has been an uncommon one in our experience. Prominence of the innominate vessels and to a lesser degree of the subclavian artery is seen very commonly in films of the chest of elderly persons, particularly those with hypertension. The outer border of the innominate may actually be convex. Some of this may be due to elongation and tortuosity of the vessel as a result of arteriosclerosis and some to dilatation, but it has little significance except in indicating probable hypertension and senile degeneration.

VII. DISEASES OF THE ESOPHAGUS AND STOMACH

Esophagus: Uncomplicated carcinoma of the esophagus rarely produces a shadow of sufficient size or density to be recognized. Occasionally, perforation may lead to mediastinitis, and the appearances are those described under that condition. Local metastasis or extension to the adjacent mediastinum or lymph nodes may, rarely, produce an area of density in the hilum or adjacent to the site of the carcinoma. The diagnosis depends on proper study of the esophagus.

Cardiospasm is not infrequently the cause of a mass shadow in the mediastinum. The dilated, tortuous, fluid-filled esophagus produces a dense columnar opacity extending beyond the normal limits of the mediastinum and in the antero-posterior view may be mistaken for a mediastinal neoplasm. Careful inspection and adequate examination will eliminate the possibility of error. A fluid level often is visible across the upper limits of the mass in the superior mediastinum, and above this the walls of the esophagus may be seen as vertical, linear densities extending up into the neck. Inferiorly, the shadow bulges more to the right side. Lateral views show a diffuse opacity throughout the posterior mediastinum. The diagnosis is confirmed, readily, by barium meal examination.

Stomach: *Herniation* of all or a part of the stomach through the esophageal hiatus may produce a mass in the inferior posterior mediastinum. When small, the herniated portion usually is obscured by the heart but may be seen in overpenetrated films. When large it may protrude beyond the cardiac borders. In the upright position a fluid level may be seen and on casual inspection a hydropneumopericardium might be suspected. A few swallows of barium will eliminate this possibility and show the nature of the condition.

VIII. BRONCHOGENIC CARCINOMA

Although the two major bronchi lie within the mediastinum and are involved fre-

quently in bronchogenic carcinoma, this disease usually is considered under pulmonary rather than mediastinal lesions, since the major roentgenologic manifestations often are due to infection and atelectasis distal to the tumor. The tumor itself may be so small that its shadow cannot be identified, and in cases observed during the early stages of the disease this is to be expected. In some carcinomas there is a tendency for the tumor to invade the interstitial tissue of the lungs, atelectasis developing rather late. In this form, and in practically all lesions during the final stages of the disease, the tumor itself produces a mass density and if it has arisen in one of the major bronchi or one of the lobar divisions, a mediastinal mass may be present, unless obscured by atelectasis, infection, or pleural effusion.

An important feature of bronchogenic carcinoma is its unilateral nature. The shadow formed by the tumor is of extreme density, merging with the hilum medially, and with the outer border smooth or fuzzy. When the lesion has produced occlusion of a lobar bronchus the atelectatic lobe may be contracted against the mediastinum and it may be difficult to determine how much of the density is due to tumor and how much to atelectasis. In the presence of any unilateral mass in the region of the hilum of the lung, and especially if there is evidence of atelectasis, bronchogenic carcinoma should be suspected and further studies directed toward establishing its identity. Among these, we have found the use of bronchography with iodized oil of value. The oil should be injected under fluoroscopic control and directed toward the area of disease. By this means filling defects often can be recognized before complete obstruction occurs and, even when a bronchus is completely obstructed, some idea of the nature of the obstruction usually can be obtained. Metastatic involvement of the mediastinal nodes may be present and add to the density. Metastatic foci in other parts of the lungs are infrequent.

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The Post-Thoracoplasty Roentgenogram with Special Reference to Posture¹

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THE RE-FORMED chest wall following thoracoplasty for pulmonary tuberculosis, as seen roentgenographically, is

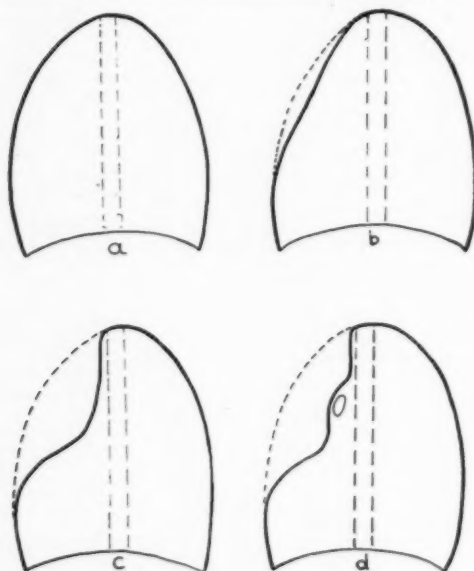


Fig. 1. Schematic outline of chest contours.

- a. Preoperative or normal contour.
- b. Contour following resection of short rib segments (Sauerbruch type thoracoplasty) over dense fibrotic lung, showing limited collapse.
- c. Contour following modern thoracoplasty (Semb type), showing ideal selective collapse.
- d. Contour showing "localized lateral convexity" over open cavity.

generally uniform and regular in outline, the contour of the regenerated ribs merging with the contour of the unresected portion of the bony thorax. In a number of instances, however, we have observed that the contour of the regenerated ribs is disrupted by a degree of outward displacement, which we shall refer to as an area of "localized lateral convexity."

The presence of this convexity was first noted a few years ago² in roentgenograms of post-thoracoplasty patients with persistent positive sputum. We believe that this lateral convexity overlies an unclosed cavity or aerated lung tissue. In some instances, it is possible to visualize the cavity under the lateral convexity with or without a fluid level.

The contour pattern of the regenerating bony cage is greatly dependent upon underlying pleuro-pulmonary conditions. Following the "deribbing" of the thoracoplasty operation, the remaining periosteal bed falls in against the pleural coverings and the lung. Where the pleura is thin and the relaxation of the lung great, regeneration of the thoracic wall results in a hemithorax which is considerably reduced in size. Conversely, when the pleura is thickened and the lung densely fibrotic, a lesser degree of collapse results, and the regenerating chest wall is not as markedly changed. Should the cavity remain open, either with or without an increase in intracavitary pressure, a barrier is created about which the regenerating bone takes form. Positive pressures have been demonstrated in certain types of tuberculous cavities. Such cavities are notoriously resistant to closure by any means of collapse therapy (1-5). The usual line of contour of the reforming ribs is disrupted and a lateral convexity results, which becomes manifest when ossification is completed.

Changes in the thoracic wall subsequent to a pleuritis or pulmonary fibrosis are

² These observations were first made at the Sea View Hospital, Staten Island, N. Y., when Doctor Gordon and Doctor Taylor were Surgical Resident and Roentgenologist, respectively.

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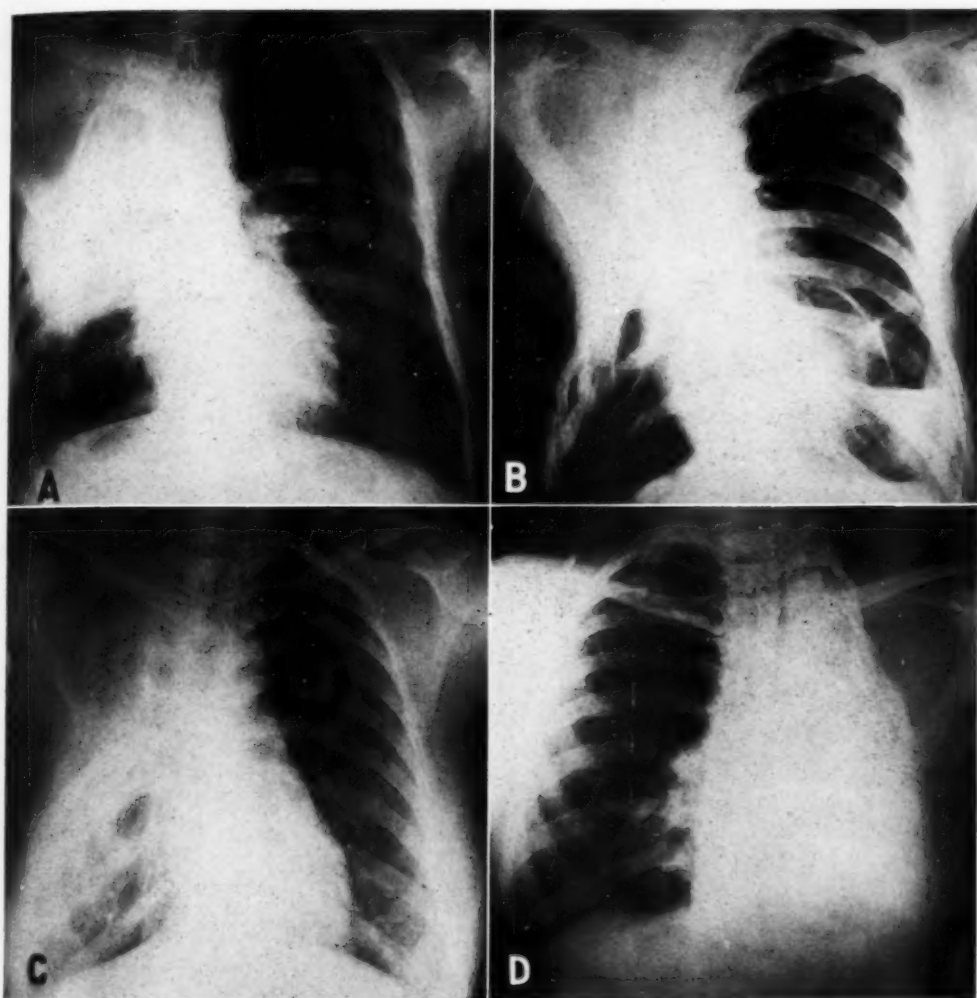


Fig. 2. A. Post-thoracoplasty roentgenogram showing "localized lateral convexity" and annular shadow. There is also an effective contralateral pneumothorax; sputum positive. B. Roentgenogram of same patient following revision operation of upper thoracoplasty and additional rib resection. Localized lateral convexity absent; sputum negative. C. Roentgenogram following modern thoracoplasty (Semb type) showing ideal selective collapse; sputum negative. D. Roentgenogram following resection of short rib segments (Sauerbruch type) over dense fibrotic lung; sputum negative.

illustrative of the influence of underlying pathology on the locally overlying ribs. It is not unusual to see a projecting tension cavity under a pneumothorax in spite of the marked degree of collapse of the surrounding lung. This illustrates well the resistance of such cavities to closure. Rib regeneration occurring around a thoracotomy drainage tube shows bony reformation about a barrier of obstruction.

A group of 78 postoperative cases was collected in which primary thoracoplasty had not been followed by negative sputum. In 63, or 80 per cent, of these cases, a prominent "localized lateral convexity" of a portion of the regenerated chest wall was seen, with no evidences of disease in the contralateral lung. In the remaining 15 cases sources for tubercle bacilli other than the original cavity were demonstrated.

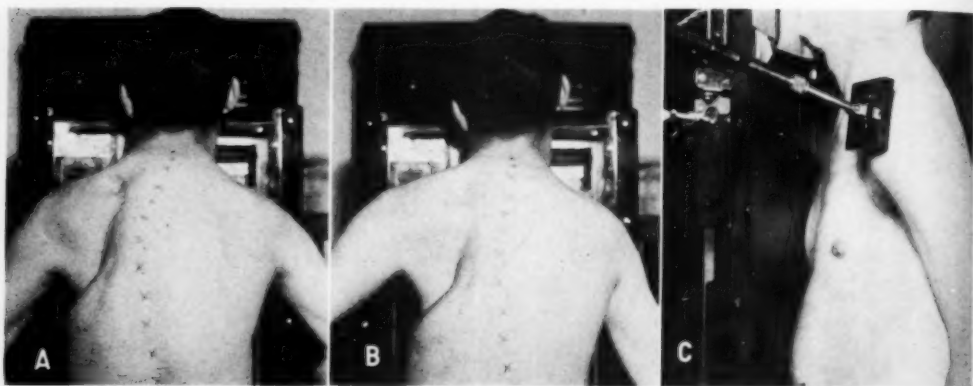


Fig. 3. A. Usual position of thoracoplasty patient with both shoulders touching cassette holder. Note curvature of spine. B. Corrected position, with the necessary degree of rotation of operated side away from cassette holder and head tilted to this side. The sternum and spine are in superimposed alignment and the position is more nearly postero-anterior than oblique. Note corrected curvature of spine. C. Lateral view showing supporting rest for patient and degree of rotation for postero-anterior projection.

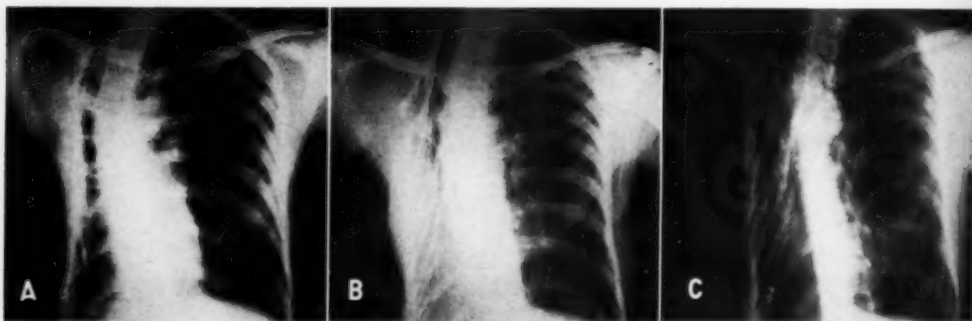


Fig. 4. A. Roentgenogram in slight oblique projection showing extensive collapse of lung. Failure to correct position of patient gives an erroneous picture of the degree of collapse; sputum intermittently positive. B. Roentgenogram of same patient taken in corrected position showing "localized lateral convexity" over a probable cavity-bearing area. C. Bucky roentgenogram of same patient showing bone detail and spread of disease to contralateral upper lobe.

These were bronchial disease, reactivated contralateral disease, and active basal homolateral lesions below the thoracoplasty. The roentgenograms of 75 successful thoracoplasty cases, those with persistent negative sputum for six months or more, were used for comparison. In the roentgenograms of these negative cases, no localized contour change in the regenerated bony thorax was demonstrable. In some of the collected cases with positive sputum, the lateral convexity was not noted following a revision operation, and in these cases the sputum became negative. Where the regenerating bone again resulted in a lateral convexity following the

revision, the sputum continued positive.

A technical error noted in the usual post-thoracoplasty roentgenogram is rotation of the patient. This is due to failure to correct for the altered structural relationship of the spine and shoulder girdle following operation. The degree of collapse is erroneously depicted from an anatomical standpoint. Such roentgenograms are unfavorable for comparison with preoperative films.

Following operation, there is a variable degree of scoliosis and rotation of the upper thoracic vertebrae (6), with a convexity of the spine toward the operated side. The shoulder girdle on the same side tends to

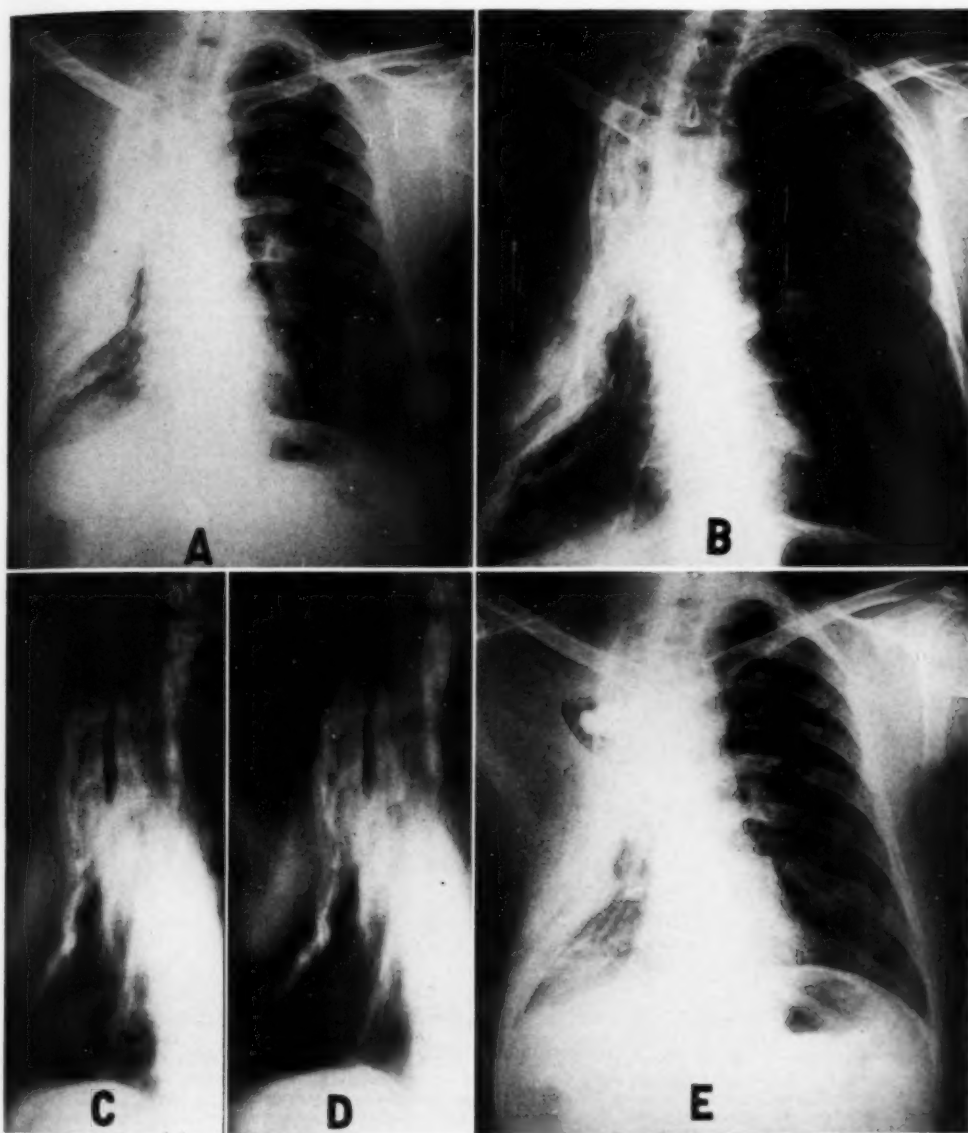


Fig. 5. A. Post-thoracoplasty roentgenogram with indefinite lateral convexity in the conventional film; sputum positive. B. Bucky roentgenogram of same patient showing bony detail and definite "lateral convexity." C and D. Tomographic roentgenogram of same patient at levels 7 and 9 cm. showing definite "lateral convexity" and slit-like cavity. E. Roentgenogram following open drainage of tuberculous cavity. Gauze pack impregnated with iodized oil confirms location of cavity on film. Preoperative intracavitary manometric readings were -3, -8.

rotate medially. It is necessary, therefore, in order to obtain a correct postero-anterior roentgenographic projection for comparison with a preoperative film, to rotate the patient somewhat so that the shoulder

on the operated side is a little away from the cassette. A sliding block temporarily fastened to the cassette holder may be of aid. This is adjusted to the proper distance to align the shoulders and serves

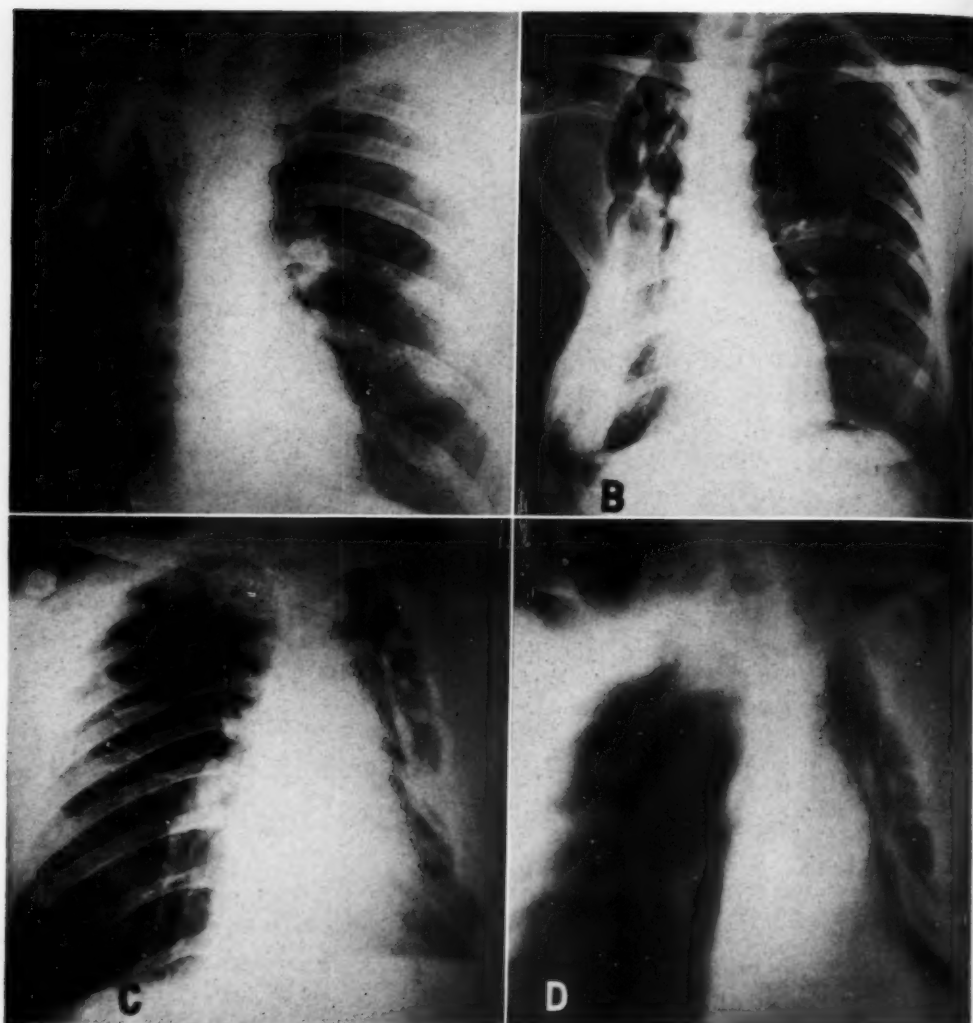


Fig. 6. A. Roentgenogram showing "localized lateral convexity" and underlying cavity with fluid level; sputum positive. B. Roentgenogram showing lateral bulge or herniation resulting from complete loss of periosteum; sputum positive. C. Roentgenogram following revision operation showing a persisting "lateral convexity." Minimal rib regeneration resulting from loss of periosteum in repeated operations; sputum positive. D. Tomographic roentgenogram of same patient showing annular shadow underlying lateral convexity.

as a rest for the patient. It is also helpful to correct the upper scoliosis by having the patient incline the head toward the shoulder on the operated side. If these corrections are not made, the true contour of the lateral aspect of the regenerated chest wall may be missed. When present, the localized lateral convexity is readily demonstrable. At times, the convexity

may be in another plane and will be demonstrated only on tangential projection.

A localized lateral displacement or contour change has been noted in other situations not necessarily related to increased intracavitary pressure or positive sputum. Where there has been an unintentional complete loss of periosteum locally, a lateral bulge or herniation may develop.

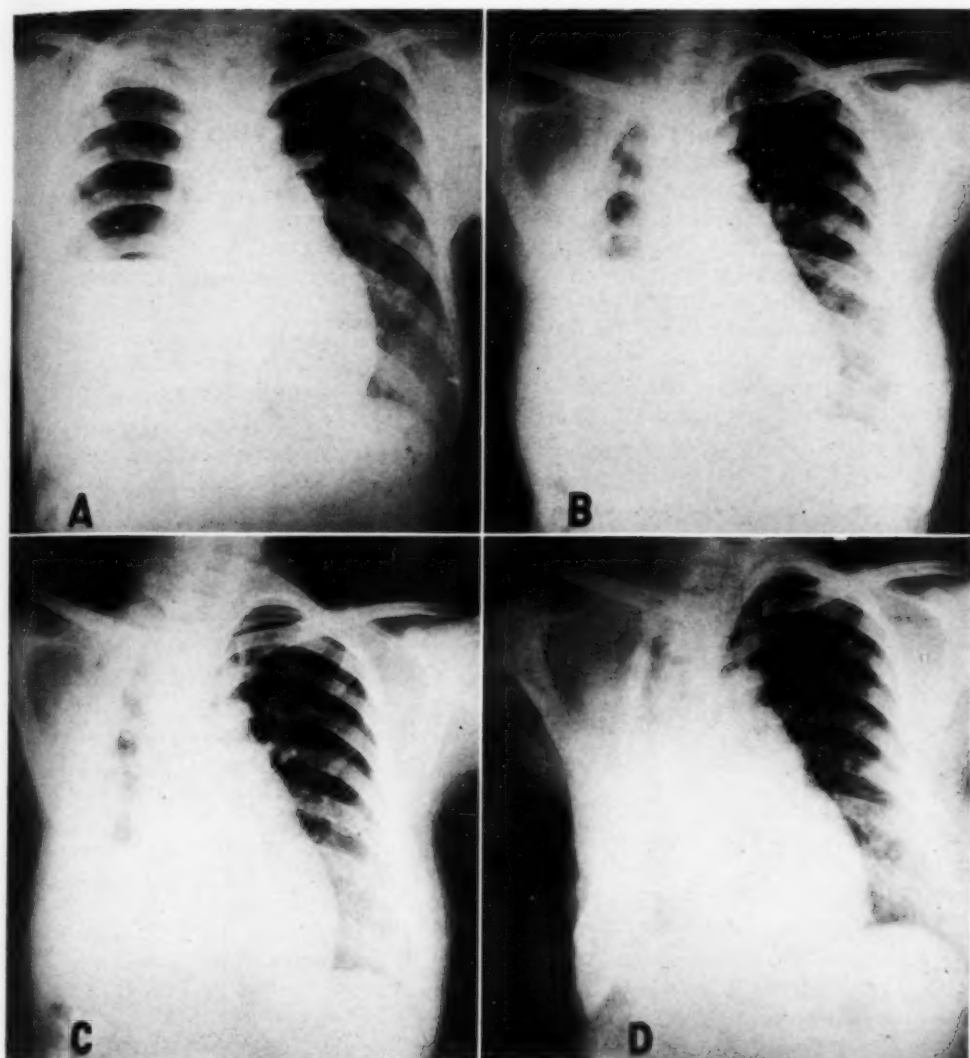


Fig. 7. A. Roentgenogram showing complete collapse of lung, fluid level and fibrin deposits on the pleurae. (Pyopneumothorax.) B. Roentgenogram of same patient following total thoracoplasty for empyema, showing generalized convexity of regenerated chest wall. Recurrence of fluid and air aspirated preoperatively. C. Roentgenogram of same patient following further operative procedures to obliterate pleural empyema space; generalized convexity persists. Presence of patent bronchopleural fistula confirmed by noting positive intrapleural manometric readings. D. Roentgenogram of same patient following Schede operation, showing obliterated pleural empyema space. Sputum had always been negative following total collapse of lung by pneumothorax.

Fluid present in the pleural cavity preoperatively and allowed to remain after thoracoplastic collapse will influence the reforming rib contour accordingly. This is probably one factor responsible for an unsuccessful thoracoplasty operation in the

presence of a hydro- or pyopneumothorax. A patent bronchopleural fistula in a closed chest beneath the thoracoplasty will alter the contour of the reforming chest wall. Here, of course, positive pressure develops, and the convexity is more generalized.

More recently, a contour change has been noted in comparing the roentgenograms of thoracoplasties done following the Monaldi (7) procedure of cavity drainage with those of primary thoracoplasties.

We believe that a localized lateral convexity may be of significance in the presence of continued positive sputum after thoracoplasty. This roentgenographic observation serves only to focus our attention upon an area which requires investigation. In some instances, the cavity may be demonstrated on planigraphic examination (8). When a localized lateral convexity is seen, it is in order to intensify the bacteriological examination to determine whether active disease is present.

CONCLUSIONS

1. The average post-thoracoplasty roentgenogram is made in slight rotation and may erroneously depict the degree of collapse.

2. It is recommended that, in making roentgenograms following thoracoplasty, consideration be given to certain structural alterations produced by the operation.

3. A contour change in the re-formed chest wall, referred to here as a "localized lateral convexity," has been observed in postoperative roentgenograms in cases with positive sputum.

4. This localized lateral convexity was observed in 80 per cent of 78 collected post-thoracoplasty cases in which the sputum was positive. In the remaining 20 per cent of this group, other sources of tubercle bacilli were found.

5. We believe that this roentgenographic observation has significance and should be looked for in patients with positive sputum following thoracoplasty.

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Roentgen Analysis of Upper Cervical Spine Injuries¹

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BECAUSE OF THE structure of the upper spine, injuries in this region resulting in a disturbance of the normal relationships of the atlas, axis, and base of the skull present a special problem.

In man the normal posture is erect, the centers of gravity of the head, the chest and the trunk (including the legs) lying along the vertical axis of the body, an alignment unknown in any other vertebrate. Examination of a normal spine shows the atlas, or first cervical vertebra, supporting the skull, to which it is firmly articulated, and resting below on the lateral articulations of the second cervical vertebra, or axis. That the odontoid process, or dens, takes part in the characteristic erectness or uprightness of man is evident. On examination of the normal axis, as it rests in tripod fashion on a horizontal plane surface, the dens is seen to be vertical. With the head in a normal upright position, the atlas ring should therefore rotate in a horizontal plane, and a vertical transverse plane passed through the center of the odontoid process should pass also through the centers of gravity of the masses comprising the occipito-atlantal-axoid condyle surfaces. This entire relationship may, however, be seriously unbalanced as the result of an accident, as for example a vehicle collision.

If the condylar surfaces were clearly visible in lateral x-ray films, upper cervical and accompanying basal injuries would be as readily recognized during life as at autopsy. Since they are not, it becomes necessary to devise some means whereby

dislocations at the condylar surfaces may be discovered by recognition of readily detectable variations from normal at other, related points.

The trauma sustained in vehicle collisions inflicts the most serious damage in the basal region, and the dens is often bent back, producing a narrowing of the normal gap between the anterior tubercle of the atlas and the upper adjacent dorsal contour of the mandible. This is demonstrable in the lateral roentgenogram, but is easily overlooked on casual study, just as any mechanical fault may be missed without definite measures to detect it.

The present paper deals with a method of precisional analysis of upper cervical roentgenograms with the aid of index lines for guidance in interpretation.

TECHNIC OF METHOD

For the method to be described here, the first requisite is a clear, accurate lateral film. To obtain this, the x-ray beam should parallel, as nearly as possible, a line through the two ear openings, and the milliamperage and other factors should be those suitable in the individual case. The procedure can be practised directly on the film, but it is better to leave this unaltered and to make a careful tracing of the outlines of the structures to be studied for the purpose of analysis.

The accurate objective analysis of an upper cervical lateral roentgenogram, in the absence of obvious incapacitating angulations, requires at least six essential guide lines for the detection of otherwise unrecognizable dislocations, fractures, and the like, which may later prove to be related to spinal cord injury. In the presence of serious upper cervical injury, it may be possible to use only five guide lines, as in Figure 11; where there is no upper cervical injury and no normal hyper-

¹ While it is unusual for RADIOLOGY to publish a paper by a layman not working in the field of radiology, the present contribution, written as a result of the author's medicolegal experience, seemed to be of sufficient interest to warrant an exception, in the hope that further research in this field might be stimulated.—Ed.

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² Member of the New York Academy of Sciences.

extension exists—in other words where the head is upright, in the normal erect position—only four lines can be drawn, since under these circumstances two of the lines coincide with the vertical guide line (Fig. 7).

The first guide line to be drawn is a horizontal one passing medially through the atlas body. This is designated *a* in the accompanying figures. Three parallel lines are then drawn, perpendicular to *a*, passing, respectively, through the point where *a* intersects the anterior surface of the upper odontoid (line *c*), the point where *a* intersects the anterior surface of the atlas tubercle (line *at*), and the point where *a* intersects the mandible (line *am*). (Where there has been a "snap-whip" type of trauma, two mandible lines may be seen, in which case a medial line, *m*, as in Figure 9, must be drawn before this last point of intersection can be determined.) A fifth line *b* is drawn along the anterior edge of the axis body, and a sixth line *ab* parallel to vertical line *c* but passing through the lower anterior corner of the axis body. The three guide lines parallel to the vertical line *c* determine three spaces, *d*, *e*, and *j*.

Three additional guide lines, *f*, *g*, and *h*, may also be drawn as of helpful significance in anticipating possible later angulation dislocations. The line *f* is drawn, as nearly as possible, tangent to the anterior surface of any vertebra below the axis. Where the anterior surfaces of two or more vertebrae appear to be tangent to a single straight line, *f* should be drawn tangent to the anterior surfaces of all these. The line *g* is drawn (see Fig. 12) tangent to the upper surface of C5, and line *h* tangent to the under surface of C4. All lines must be accurately ruled straight lines to be of objective diagnostic significance.

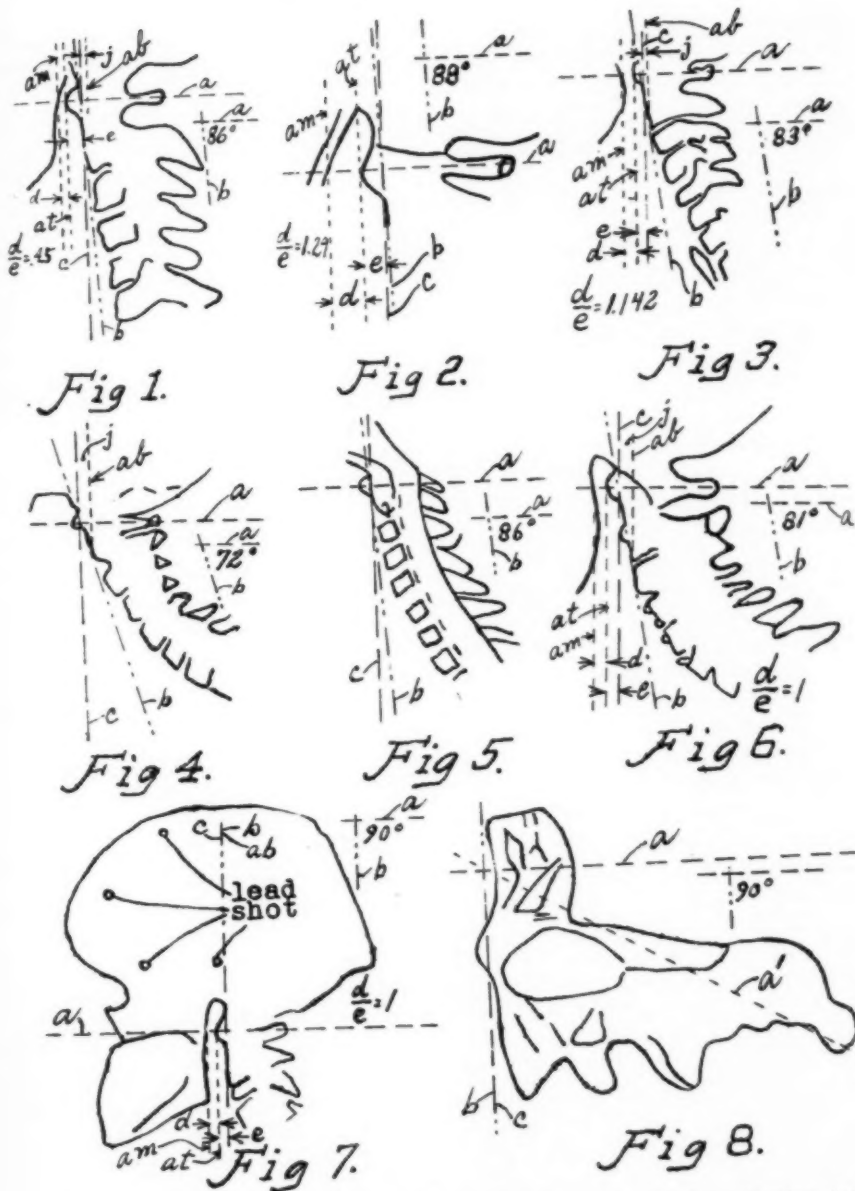
It is to be borne in mind that the guide lines described here are of full significance only when the roentgenogram has been made with the patient in the normal erect position. With the head in hyperextension their value is seriously impaired (see, for example, Figures 4 and 6). As a precau-

tion against malingering, the physician's report should include a statement of the ratio of the length of the atlas to the radius of curvature of the cervical spine, which ratio should be small. Spaces *d* and *e* will not be appreciably affected by either flexion or extension of the head, since the distance from the center of the occipito-atlantal condyles to the nearest point on the mandible is quite short and does not change significantly with any nodding position. Nodding, furthermore, when appreciable, involves the co-operation of all the cervical vertebrae and not exclusively the occipito-atlantal condyles, as heretofore assumed.

APPLICATION OF METHOD

To illustrate the suggested method of upper cervical roentgenogram analysis, a number of figures are included. Figures 1 to 8, except Figure 6, are tracings from medical texts. While several of these figures are described in the accompanying texts as normal, the only one in which there is actually no demonstrable abnormality is Figure 7, in which gunshot wounds of the head and brain left the upper cervical region intact. This figure shows all the essentials of a normal view, *i.e.*, space *d* is equal to space *e*, making the ratio of $d/e = 1$. Also, the guide line *c* shows the atlas tubercle to its left, as it should be, and test line *a*, medially through the atlas, is at right angles to test line *b*, which properly coincides with test line *c*, as does also the test line *ab*. Note particularly that test line *c* actually does pass through the center of mass of the cranium, thus demonstrating the normal balancing of the head on the top of the spine.

Figure 1 (1) is described as a normal lateral view, but there is evident an irregularity along the anterior vertebral edges that suggests previous trauma. The ratio of spaces *d* and *e*, which we may call the *m-t* (mandible to tubercle) ratio, is 0.45, or only half the normal, indicating a backward slipping of the occiput on the atlas, while space *j* indicates a slipping, of about an equal degree, of the atlas backward on



Figs. 1-8. Tracings of roentgenograms of the cervical region, showing the application of the suggested method of analysis. All except Fig. 6 are taken from medical texts. For the references and for detailed explanation, see text.

the axis. The rear of the atlas is, however, properly midway between the occiput and the axis spinous process, and the angle between lines a and b (which we may call the *atlas angle*) is about 95 per cent normal,

suggesting the probable occurrence of a severe horizontally applied punch to the mouth.

Figure 2 (2) is also described as a normal view, but here the rear of the atlas

is proportionately too close to the occiput, and there is a corresponding increase in the $m-t$ ratio to 1.29, and the atlas angle is about 98 per cent normal. In this case the injury was probably the result of an upper-cut to the jaw.

Figure 3 (3) also shows evidence of trauma. The $m-t$ ratio is a little high, the rear of the atlas is correspondingly too close to the occiput, and the atlas angle is 95.5 per cent of normal.

Figure 4 (4) is a normal lateral view taken in the recumbent position with the head extended, as is evident from an accompanying photograph in the original text. It illustrates clearly how incorrect positioning may produce a false space j and a false atlas angle in the absence of any pathological change.

Figure 5 (2) shows the relation of the spinal cord and medulla to the normal or nearly normal occipito-atlantal-axoid articulation and contributes to an understanding of the chronic suffering resulting from traumatic concussion due to a snap-whip type of vehicular or other injury with dislocation of the entire cervical spine, which has for the most part recoiled except for tell-tale dislocations in the occipito-atlantal-axoid region, readily recognizable upon proper analysis. Note especially the anterior indentation at the cord-medulla juncture immediately behind the transverse atlas ligament, back of the odontoid, which is always bent backward in such an accident. Pressure is exerted by the odontoid and dislocated atlantal-axoid bones, through living tissue, against the ventral fibers of the upper spinal cord, with much internal hemorrhage, useful for healing only when the displacements are immediately recognized and proper immobilization is initiated. Otherwise cicatrix formation ensues with consequent intractable pain and permanent unilateral muscular contractions.

Figure 6 is a tracing of a lateral film of a healthy girl six years of age. The roentgenologist permitted a normal hyperextension, which, as pointed out above, should never be allowed, since, as in Figure 4, a

false space j and a false atlas angle are created. The normal $m-t$ ratio, however, contradicts any assumption of pathology, at least as far as the lateral view is concerned.

Figure 7 (5) has been described above as showing normal relations in spite of the injury to the skull and brain.

Figure 8 (6) is a reproduction of a view of the axis appearing in repeated editions of *Gray's Anatomy*. Unfortunately it is not a true lateral view, for in such a view the right condyle would not be seen protruding anteriorly to the body of the axis, but the condyles and body of the axis would be in direct alignment with each other, as would also the articular and transverse process surfaces. When these corrections are made, it is obvious that the axis shows normally an anterior concavity including the odontoid process. From an inspection of this figure it is clear that, if test line a is bent back to position a' , making an angle of 60 degrees, for example, with line b , not only must the odontoid be bent back but the atlas would also have to be lifted upon the odontoid prior to the inevitable recoil. This should help us to understand the type of injury shown in Figure 9, in the presence of which prudent physicians have warned against moving, turning, or manipulating the head for testing or therapy (7, 8a, 9, 10).

Figures 9-13 show the application of this method to successive lateral views in a definite case of known etiology. The patient was seated in a parked transit bus, with his right shoulder against the hard back seat and his head tilted back and turned to the extreme right, as he was looking into the face of a fellow passenger. At that instant a heavier bus crashed into the parked bus from the rear. The patient's atlas, which rotates with the cranium, was in such a position that its more massive left side forced the odontoid backward, resulting in a permanent injury.

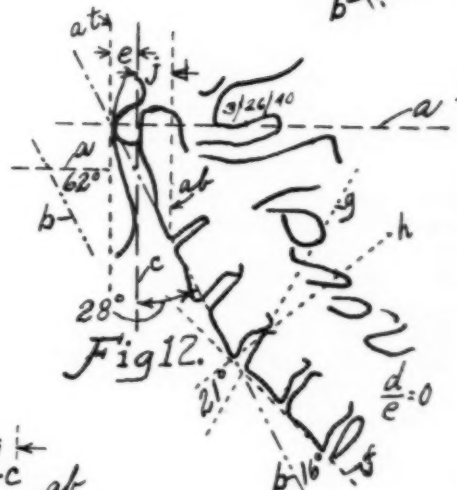
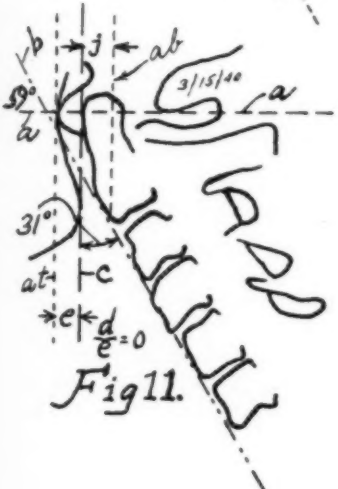
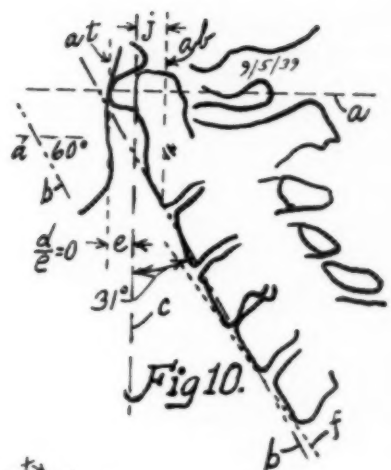
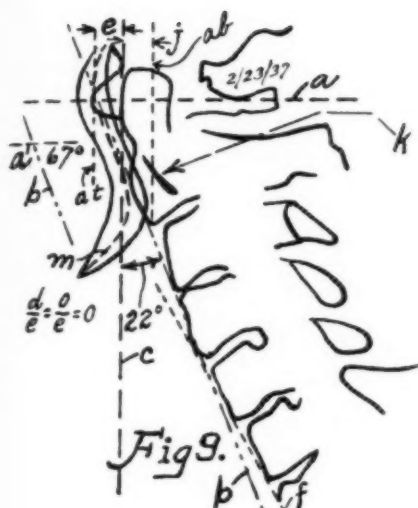
The occipito-atlantal-axoid condyles cannot themselves be demonstrated in a lateral roentgen film. As they are jerked backward, however, as the result of such a

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Figs. 9-13. Tracings of successive lateral roentgenograms in a case of permanent cervical spine injury resulting from a vehicular accident. See text.

collision as has been described, the cranium slides back on the atlas and the atlas slides back on the axis. At first, the pain radiating from the vicinity of the mastoid down to the corresponding shoulder is usually of little consequence. It is often ignored by the patient. Though muscles, ligaments, nerves, and vessels are strained, there is little external evidence of this. The heavy, still healthy and elastic muscles and ligaments, radiating in many directions from the upper articulations, produce an inevitable recoil, springing back, and spontaneous reduction of most of the displacements that occur (8*b*, 11, 12). The common, capsular, and other ligaments in the cervical region bind the soft, spongy-centered vertebrae so firmly together that an injury is very likely to cause a vertebral fracture (13) or there may be a fracture of the intervertebral disk or disks (8*c*), and in practically every such case trauma to the spinal cord is inevitable (14, 15). Lack of precision analysis has resulted in such gross discrepancies between the diagnosis during life and the later postmortem findings that a prudent roentgenologist even went so far as to suggest that the term "negative" should be dropped from the roentgenologic nomenclature (16).

By an analysis of the films in the case to be studied by the technic described here, it is possible to determine the nature of the injury and to appraise its extent. As a preliminary step, a curved line *m* must be drawn in Figure 9 between the two mandible lines to obtain the true compensated mandible position. The test lines *a*, *c*, *b*, and *at* and *ab* are next drawn, as described on page 50. It will be noted that line *am*, which would normally lie parallel to *c*, passing through the point where line *a* intersects the mandible, cannot be drawn separately because of the complete elimination of the normal space between the mandible and the atlas tubercle. Line *f* may be drawn in anticipation of a recoiled dislocation later temporarily made visible in Figure 12. In Figure 12 lines *g* and *h* may also be drawn to demonstrate more

clearly and objectively the angulation dislocation between C4 and C5.

A study of the relationships of the lines described leads at once to certain diagnostic conclusions. Loss of space *d* (between lines *am* and *at*), which in the normal film should be equal to space *e* (between lines *at* and *c*), signifies a dorsal dislocation of the occiput measurable on the full-scale tracing of Figure 9, occurring at the occipito-atlantal condyles. The space *j* between *ab* and *c* points to a dorsal dislocation of the atlas on the axis, of about the same degree, occurring at the atlanto-axoid condyles. The angle between lines *b* and *c* indicates that the odontoid was simultaneously bent backward about 22 degrees (Fig. 9), and the complementary angle, which would normally be 90 degrees, signifies a backward dislocation of the atlas to 67 degrees.

Test lines *f* and *b* reveal anticipatory evidence of a recoiled dislocation somewhere near C4 and C5, which shows up later (Fig. 12) after further progress of the injury in the absence of immobilization. Synovial, hyaline, and perichondrial tissues, cartilages, lymph nodes, nerves, small blood vessels, and ligaments were injured. Because the odontoid usually cannot be bent further forward than its existing static pathologic position in Figure 9, and because the atlas cannot move counterclockwise appreciably from its dislocated position, the inevitable posttraumatic progress of the injury is as revealed in Figures 10 to 13, which cover a period of over three years. The dislocation seen in Figure 12, and recoiled in Figure 13, could not have developed without preliminary dislocations higher up. Incidentally the diagonal curved line at *k* in Figure 9, which represents a shadow showing considerable variation in subsequent lateral films, signifies not a transverse or articular process, since these do not show up clearly in any cervical lateral view, but is evidence of an internal fracture in the soft spongy substance of the axis body, inevitable as the odontoid bent backward. The x-ray analysis in this case,

as presented here, was substantiated by the clinical findings reported from time to time.

The objective evidence, furnished by way of lines, angles, spaces, ratios, and logical deductions, is helpful in avoiding such diagnoses as "negative," "neurosis," "hypochondria," and "arthritis," and in indicating the true nature of the injury. The invisible condyle dislocations and the odontoid and atlas dislocation demonstrated in Figure 9 were ample to injure the spinal cord, and it is easy to understand how, in the absence of precision analysis, a well known neurologist (15) could state with great emphasis that the cord may be injured even though the x-ray shows "no dislocation whatever." A vivid post-mortem picture is shown (Fig. 490, p. 461) in a fairly recent text (8), revealing one way in which the cord may be injured by a hemorrhage prior to the inevitable recoil.

SUMMARY

A method is described making it possible by the use of certain guide or index lines to determine objectively from lateral roentgenograms the nature and extent of the bony components of upper cervical spine injuries. The neurological components of such injuries, which are often of primary

importance, cannot, of course, be assessed roentgenographically.

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A Method for the Localization of Foreign Bodies and a New Instrument to Carry Out This Method

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DURING WORLD WAR I, there passed through Base Hospital No. 42, at Bazoilles, France, to which I was attached, a large number of the American wounded. The procedure for foreign body localization there used was almost entirely the near point method, which, for obvious reasons, was not always successful. The surgeon was constantly complaining that the foreign body was not found at the site indicated by the technician.

At the time, it occurred to me that some method of remedying this difficulty could be devised, which would still be simple of operation. Not having the facilities to work with, I roughly constructed the apparatus to be described here. This I demonstrated before a group of physicians, among whom were Colonel Harrison and Dr. John Evans, both of Baltimore. This was in December 1918. Now that we are engaged in another war the possibilities of the procedure seem to warrant its publication in the hope that it may be of some use in the present conflict.

The method is so simple that little previous training is necessary for its use. The apparatus requires only slight modification of the present standard x-ray equipment. The surgical instrument for interpretation is easily operated and readily sterilized.

The method is based on the principle of parallax, namely, on the fact that shadows of bodies at an equal distance from the x-ray tube move equal distances on the fluoroscopic screen when the tube is shifted back and forth.

In order to carry out the procedure, two separate pieces of apparatus are necessary.

APPARATUS NO. 1

Apparatus No. 1 consists of two parts, which for purposes of description will be designated Apparatus No. 1A and Apparatus No. 1B. Both of these parts, however, assemble into a single unit.

Apparatus No. 1A: This consists of a fluoroscopic screen which moves with the length of the table and parallel to it. It moves, also, at a right angle to the length of the table, and can be raised or lowered any desired distance from the table. This screen (Fig. 1) is ruled with one center line, LM, running lengthwise, and with parallel lines, AB, which run at right angles to LM.

The tube beneath the screen and table, except when released, follows all lateral motions of the screen, so that the vertical ray is always centered with the centerpoint O on the screen.

Apparatus No. 1B: In conjunction with the screen, there is an arrangement of calipers (Fig. 2) having neutral points, zero, on a graduated scale and arms J and J' that open and shut at any given distance from the neutral points. These are of aluminum, with lead tips, T and T'. They can be raised or lowered, and a line connecting the tips will always be parallel to the plane of the fluoroscopic screen and table. The tips are also always in the vertical plane with point O and in a plane at right angles with the plane of the table.

When the arms are set at zero the tips will be together and in the vertical ray, and their shadows will coincide with point O on the screen.

The fluoroscopic screen and calipers are joined by means of a sliding track. The screen is directly attached to the bracket from the standard and the calipers oper-

¹ Accepted for publication in June 1942.

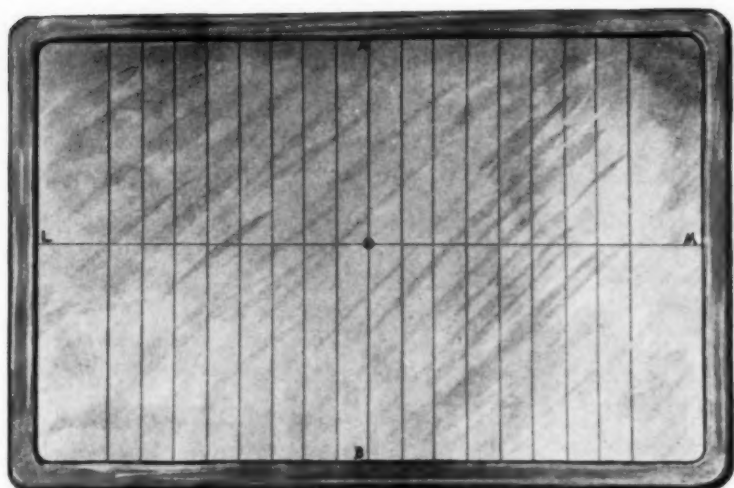


Fig. 1. Fluoroscopic screen with rulings to facilitate use of parallax. Center point O indicates vertical ray position on line LM.

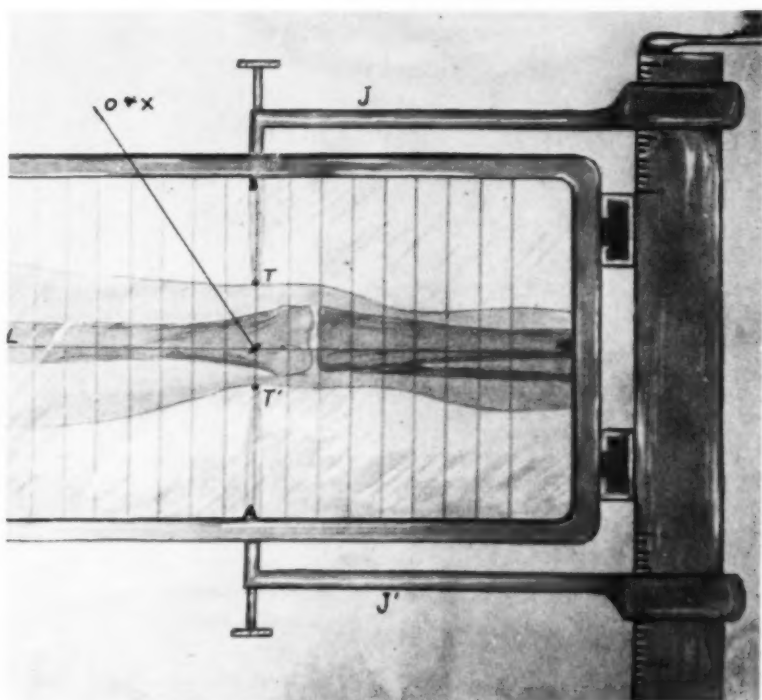


Fig. 2. Calipers-screen combination showing jaws J and J'; also tips of calipers, T and T', and foreign body, X, at point O on screen, in vertical ray position.

Note track at point where calipers and screen join. This is operated by a lever at the end of the scale beam, raising and lowering the calipers.

ate on the screen. A cam and lever operate the calipers, permitting them to be raised or lowered on the screen but always keeping their relative positions laterally (Figs. 2 and 6).

This combined apparatus (screen and calipers) is mounted on the standard counterbalanced support but the support is mounted on an extension of the tube box and not independent from it. *Thus when the tube box is moved, the screen and the*

The purpose of these markers is for detailed measurement, especially when the *special procedure* is used, as described later.

APPARATUS NO. 2

Apparatus No. 2 (Fig. 4) is for the use of the surgeon in interpreting the x-ray markings and indicating the position of foreign body. This appliance consists

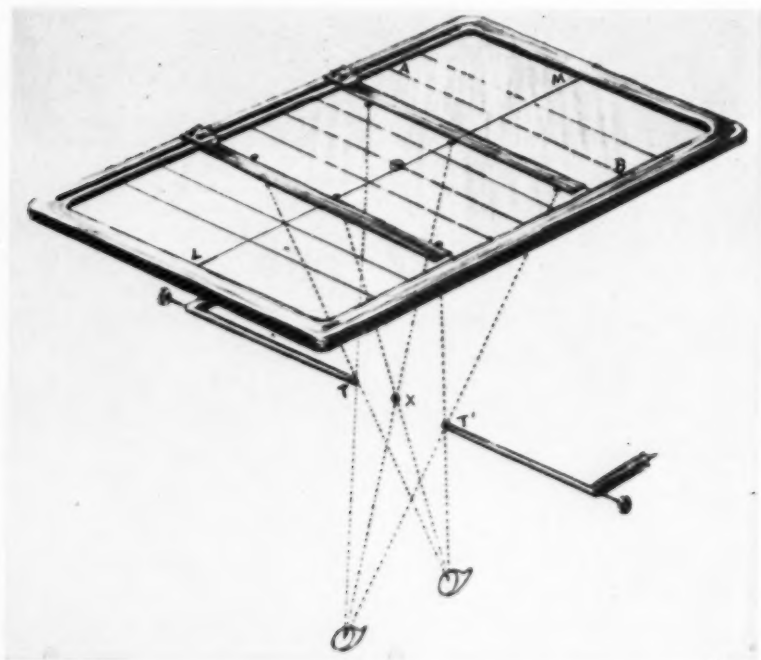


Fig. 3. Fluoroscopic screen with sliding markers to insure greater accuracy. They are essential when the shadows of the foreign body and that of the caliper tips are not visible on the screen at the same time.

calipers follow in all lateral motion except at the time when the tube box is released for the parallax procedure.

Superimposed on the fluoroscopic screen are sliding markers that operate from the frame of the screen. They lock in position and can be released by thumb and forefinger pressure (Fig. 3). The markers can be moved to right or left of the shadow of the foreign body, but they always remain parallel to each other and to the lines AB on the screen.

of a square rod of steel formed into a semicircle (S). At the tips of the semicircle are two sliding pointers, P and P', which, when fully inserted, form the diameter of the half circle. There is also a third sliding pointer, P'', that can be moved anywhere on the arc. This pointer always points to the center of the circle from which the semicircle is formed. The pointers are marked in inches. Standards are provided to support this instrument when in use (Fig. 5).

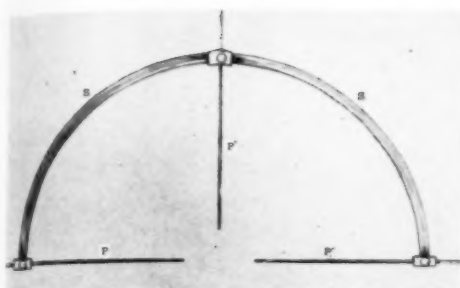


Fig. 4. Instrument for interpretation of x-ray markings and for localization of foreign body.

METHOD OF PROCEDURE

The patient is placed in the horizontal position on the table, and the fluoroscopic screen and caliper combination (Fig. 2) is placed over the part containing the foreign body (X) to be localized. The screen is moved until the shadow of the foreign body falls on the center line (LM) and the vertical ray (O). This will place the foreign body, the point O, and the tube all in the vertical ray position. A line drawn through these points will be exactly at right angles to the plane of the table. The arms of the calipers are then applied to the part and the tips of the calipers (T and T') are brought to the skin surface on either side of the member containing the foreign body.

The screen is now fixed to avoid all lateral motion, only allowing the arms of the calipers to open or close and to be raised or lowered. The tube is then released from the vertical ray position and shifted back and forth with the length of the table and the calipers are raised or lowered until the foreign body and the caliper points are on the same plane (by the principle of parallax). At the points where the caliper tips touch the flesh, indelible markings are made and the readings on the calipers are taken. Each half of the calipers will register the distance from the foreign body to the skin surface on the respective side.

We now have the patient with two marks on the member containing the foreign body. A straight line drawn through these points

will pass through the foreign body, while the distance of each mark from the foreign body is known from the readings on the calipers.

It is not necessary to have both tips of the calipers in view at the same time on the screen. In fact, this may be impossible, as in the case of a foreign body in the mid-chest or abdomen of a large subject. However, as the tips of the calipers are always in a plane parallel with that of the screen and, second, as a line connecting the tips is always parallel to the center line AB on the screen, it is necessary only to have one tip and the foreign body in view at one time on the screen.

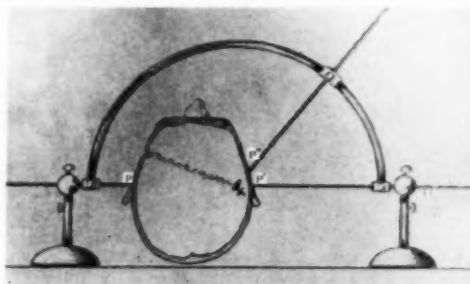


Fig. 5. Localizer applied to member containing foreign body. Note that the supports are adjustable, that the point X (foreign body) forms the center of the arc, and the line PP' forms the diameter.

If, in the event it is impossible to view the foreign body in the vertical ray and, at the same time, one or both of the caliper tips, then the following special procedure is necessary.

Special Procedure: Locate the foreign body in the vertical ray; lock the longitudinal carriage. Shift the transverse carriage until the shadow of the foreign body appears to one side of the screen on the mid-parallel line. The caliper tip on the side toward which the shift is made will come into view. The shadow of the foreign body will now be on one side of the screen and that of the tip on the other (see Diagrams A and B). Lock all carriage motion except the tube box carriage release for the parallax. In this way the caliper point and, automatically, its twin can be located on the same plane,

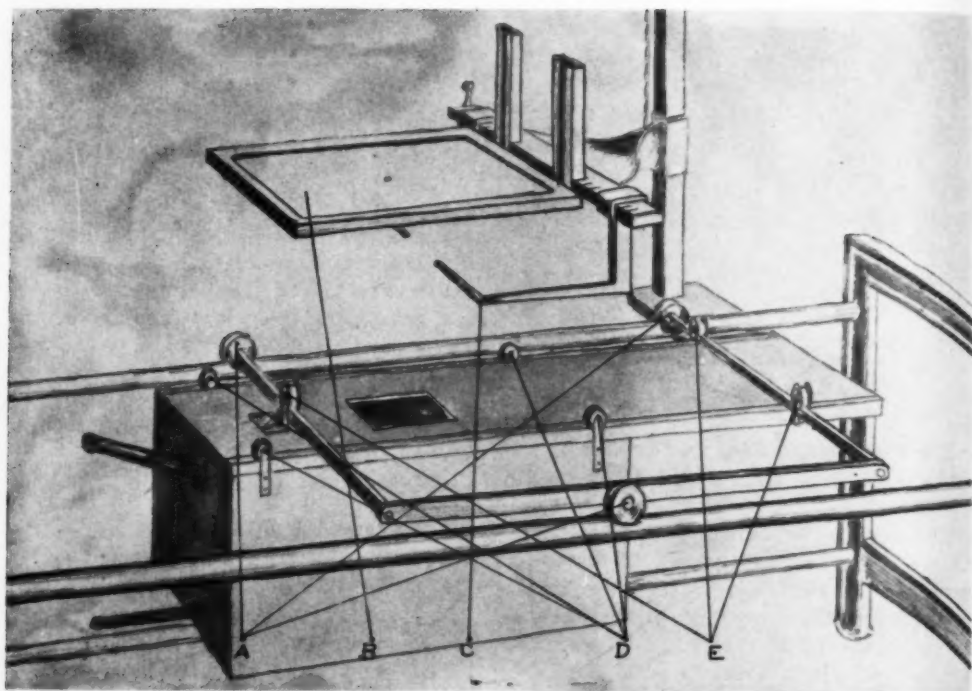


Fig. 6. Table with litter top removed. Calipers-screen combination synchronized to vertical ray by mounting on tube box extension. A. Longitudinal carriage. B. Screen. C. Calipers. D. Tube box carriage for parallax. E. Transverse carriage.

There is an adjustment to facilitate bringing the center point (O) on the screen into the vertical ray. This is located at the point where the counter-balance standard joins the tube box extension.

horizontally and vertically, as the foreign body. Return the transverse carriage so that the foreign body will again be in the vertical ray. Apply the caliper points to the skin surface (even though they are not visible on the screen). Mark the points of contact on the skin and take the readings on the calipers.

Optional Method: If it is impossible to view the shadow of the foreign body and that of one of the caliper tips at the same time even by the shift from the vertical ray position, the method of procedure is as follows:

(1) View the foreign body on the screen in the vertical ray. With all carriages locked except that for the parallax, move the tube a *measured distance* and mark the point of the shadow on the screen.

(2) View one point of the calipers on

the screen in the vertical ray and, with the *same measured tube shift*, raise or lower the caliper point until its shadow shift coincides with that of the shadow of the foreign body.

(3) Return the tube to its original position so that the foreign body is in the vertical ray.

(4) Bring both caliper points to skin surface, mark the points of contact, and take the measurements on the calipers.

The above method will rarely be required and should be used only when absolutely necessary.

The data thus obtained are interpreted by the surgeon with the aid of apparatus No. 2 (Fig. 5). The two pointers P and P' that form the diameter are set for the readings given by the calipers. The apparatus is then applied with the third pointer (P'') drawn back to the zero

mark and P and P' in contact with the indelible markings, already placed by the technician, with holders to keep them in position, as shown in Figure 5. The third

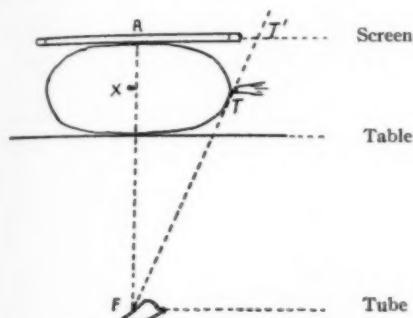


Diagram A. Vertical ray shadow of projectile appears on center of screen (R) and that of caliper tip (T') off the screen.

pointer (P'') is then lowered to the flesh at any point on the circumference where it is desirable to operate for removal of the foreign body. This pointer will always point to the foreign body (X) no matter from what arc of the circumference it is lowered. It also makes no difference whether the instrument is applied to the subject in the prone or supine position. The holders can be raised or lowered and the instrument fixed at any position.

COMMENT

This method is intended to simplify the location of foreign bodies. It involves no lengthy figuring or trigonometry. All measurements are mechanical and automatic, being read directly from scale. The time necessary for carrying out the procedure is brief. The instrument for interpretation by the surgeon is easy to comprehend and readily sterilized.

The method is thus rapid, accurate,

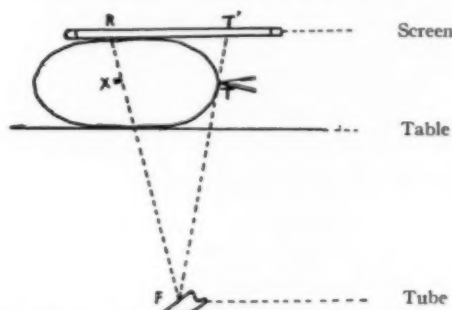


Diagram B. By moving tube and screen to right, the shadow of both projectile and caliper tip (R and T') appear on the screen.

and simple. Any roentgenologist can localize a foreign body by this method in a few minutes, and any surgeon can adjust the localizer in two minutes.

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The Problem of Recovery from Radiation Effects¹

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THE EVALUATION of the recovery of tissues from the effects of radiation offers one of the most difficult problems of radiation therapy. This paper considers the subject from three aspects: (1) biologic, (2) photochemical, and (3) clinical.

other stimulus, is capable of producing three types of effects:

(a) *Reversible effects*, i.e., transient changes, ending in complete morphologic and functional restoration of the original integrity of the tissues.

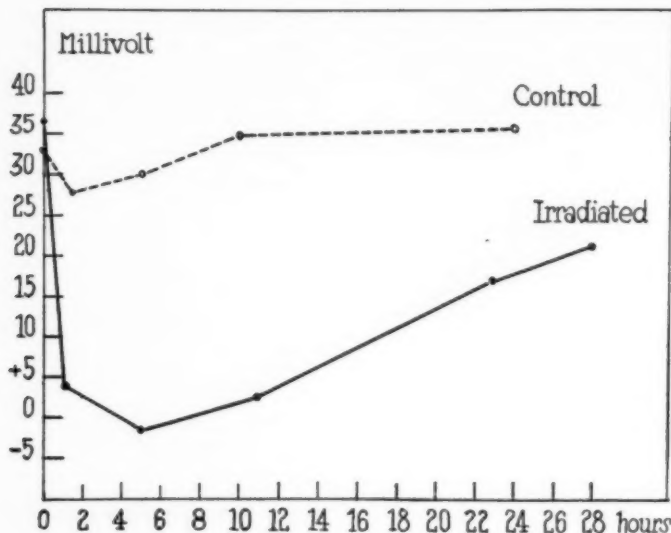


Fig. 1. Variation of the electrical cell potential of collodion membranes. Note the breaking down of the cell potential of the irradiated membrane which reaches a negative value five hours after exposure to ultraviolet rays. The changes in the cell potential are due to a photochemical process within the collodion mass (splitting off of nitro-groups). By diffusion of the photochemical decomposition product, the restoration of the cell potential takes place. This is an example of recovery by means of the so-called "washing-away effect."

Facts concerning the recovery of single cells, tissues, and organs gathered from experimental and clinical observations will be presented and an attempt made to evaluate them.

1. *Recovery Considered from the Point of View of General Biology:* From the point of view of general biology, the problem of recovery from effects of radiation is one of cellular physiology. Radiation, just as any

(b) *Conditioned reversible effects*, i.e., transient changes, ending in incomplete restoration. These changes may be followed by complete morphologic restoration but with modified function, or the morphological picture and the cell function may both be fully restored, but a second dose of radiation of the same amount, or even a smaller, will not lead to restoration of the original tissue state.

(c) *Irreversible changes*, i.e., changes that do not permit ultimate restoration at all.

¹ Presented before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1-5, 1941.

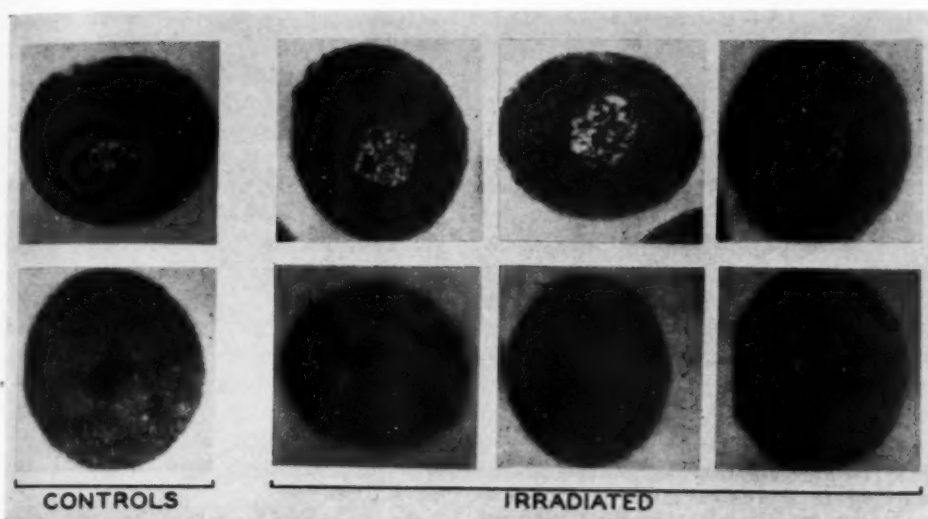


Fig. 2. Photomicrographs showing the mitotic configurations of zygotes whose sperm had received no radiation (controls) and whose sperm had received 62,400 r (irradiated). As can be seen, the problem of recovery of even a single cell is complicated by the fact that cells may be injured, although they appear undamaged. In spite of what appeared to be normal motility and function, the insidious cell injury was manifested after insemination with irradiated sperm, by the appearance of multipolar cleavage followed by death. (Courtesy Dr. P. S. Henshaw).

Which of the three above-mentioned effects occurs depends on the amount of radiation and the so-called "specific susceptibility" of cells (*e.g.*, phase of mitosis, metabolism, etc.).² Only reversible effects can be considered as leading to recovery.

2. *Recovery Considered from the Point of View of Photochemistry:* According to our present concepts, irradiation produces new substances in the cells of the human and animal body which have been held to be toxic compounds. On the basis of this photochemical theory of the effects of radiation, Holthusen (32) has explained recovery as follows: (a) The substances formed photochemically are recombined into their original compounds by a reversible chemical reaction. In photochemistry there are many examples of such reactions. (b) The photochemical products are removed from the tissue by mechanical means, *e.g.*, diffusion ("washing away effect"). This theory is supported by experiments of Ellinger (11), using collodion as a model of a cell membrane.

² For detailed data on this problem see Ellinger (12).

3. *Recovery Considered from the Clinical Point of View:* From a clinical point of view, recovery means restoration of organ structure and function. This restoration may result from replacement of damaged cells by proliferation of cells which have escaped radiation injuries, or from the recovery by the injured cells of their original function. The latter is designated as "true recovery" and the former as "pseudo-recovery." Strict distinction between these two terms is necessary for the proper evaluation of experimental and clinical facts on recovery.

EXPERIMENTAL AND CLINICAL OBSERVATIONS

Recovery of Single Cells: Cells which on microscopic examination show radiation injuries (changes in the nuclear chromatin or vacuolization of the cytoplasm) usually do not recover, though they may complete the process of mitosis.

The problem of recovery of single cells is complicated by the fact that cells may be injured though they appear undamaged. This was demonstrated as early as 1912 by the Hertwigs (30), using eggs and sperm

of the frog and the sea-urchin. They found that irradiated eggs were capable of dividing in due time and irradiated sperm was still capable of fertilizing eggs. In spite of what appeared to be normal functioning, the insidious cell injury eventually became manifest, for usually only two or three additional cell divisions took place, followed by death. Henshaw (28) has described multipolar cleavage in *Arbacia punctulata* as a consequence of irradiation of either gamete (eggs or sperm) just before fertilization. This phenomenon also finally led to cell death. In their experiments with tadpoles Spear and Glucksmann (65) were able to show that "the cells which have escaped destruction at the earlier stages of the mitotic processes may succumb, nevertheless, at later stages of division." Reduction of radiation injuries resulted from lowering the temperature of exposed cells. This fact is demonstrated by the experiments of Packard (46), using *Drosophila* eggs, Evans (17), using grasshopper eggs, Cook (2), using *Ascaris* eggs, and Henshaw (27), who used the eggs of *Arbacia punctulata*, the eggs being cooled immediately after irradiation. Packard (47) believes that the common factor in these cases of recovery is "the low reproductive and metabolic rate of the cells" following cooling.

Henshaw and co-workers (29) showed that a certain dose of roentgen rays produced a delay in the onset of the first cleavage in eggs of *Arbacia*. The delay was less pronounced, however, if a longer exposure time was used to give the same dose. Although these results could not be confirmed in another series, using eggs of *Cumingia*, they seem to be of interest in the study of the problem of the protraction of the dose in radiation therapy.

The above-mentioned examples of recovery may be explained on the theory that toxic substances are formed during irradiation. It may be assumed that these toxic substances hinder some of the metabolic processes accompanying growth, but that they must reach a threshold value before they can become effective. The more

or less complete recovery would then depend on whether or not enough time elapses for removal of the substances by diffusion or their conversion into their original form or into a non-toxic form before cell death or irreparable damage occurs. In the light of this photochemical theory, the recovery of *Paramecia*, as described by Hance and Clark (23), can be easily understood if their enormous radioresistance is considered.³

Since the term "true recovery" denotes complete restoration of cell function the work of Muller (45) is of special importance. Muller showed that hereditary changes in cells (mutations) may result from irradiation. Further studies have revealed that mutations may not manifest themselves before the second or third generation of irradiated cells.

As may be seen from this short survey, "true recovery" of a single cell from injurious effects induced by irradiation still remains a complicated problem. No doubt such "true recovery" has been shown to be possible, but so far only under very special experimental conditions which can hardly be expected to be reproduced in the organs or tissues of the human or animal body.

Recovery of Tissues: The problem of recovery of tissues has been successfully studied in tissue cultures. By this method the indirect influence of circulation and nerves is eliminated.

Experiments along this line have shown that after a latent period the irradiated tissue cultures show inhibition of growth for a varying period of time (seven to twenty days), after which the rate of growth in the irradiated and control cultures is the same. Examples may be found in the work of Santesson (59), using embryonal fibroblasts and a dose of 2-3 S.E.D; Spear (62), using embryonal chorioidea and delivering 469 Sievert units⁴ for three to six hours; Laser (37), using osteoblasts and one-eighth of the erythema dose,⁵ and others.

³ Lethal dose 500,000 r (Piffault, 50).

⁴ Sievert unit is equal to 1/7.5 r/minute.

⁵ The "immediate" lethal dose for fibroblasts is about 120,000 r (Doljanski, 4).

The recovery of tissues, as described above, may be explained by the fact that the irradiation did not kill all cells. On this assumption, the observed recovery is due to growth occurring in the undamaged surviving cells and represents, therefore, a typical case of "pseudo-recovery."⁶

Investigations on tissue cultures by Spear (63) and Spear and Grimmet (66) showed that when a certain dose of radiation was given with low intensity (long exposure) the effect was less than when the same dose was given with high intensity (short exposure), suggesting that an active repair process was going on in the cells of the tissue cultures during irradiation. Some light has been thrown on the mechanism of this recovery by the experiments of Krontowski (36), Strangeways and Fell (68), and Schubert (61). These workers showed that sub-cultures from tissues irradiated with a dose sufficient to check growth will grow if the explantation is done shortly after irradiation, or if the piece of tissue used for the explantation is first washed with Ringer's solution. These experiments again support the hypothesis that the effect of irradiation is due to the formation of toxic products from cell decomposition. This has also been suggested by A. Fischer (20). Recovery from injurious effects of radiation would then be the result of a "washing away" of toxic decomposition products (31, 32). The studies cited also support the importance of blood circulation in the problem of recovery from injurious effects of radiation, as shown by Harker (25) and Spear (64). On the one hand, radiation may increase the blood flow by vasodilatation due to photochemical formation of histamine-like substances (Lewis, 41; Ellinger, 8-11) and thus improve recovery. On the other hand, a decrease in the blood flow by vascular obliteration may prevent a possible recovery.

From the above facts, the following conclusions may be drawn. True tissue re-

covery is conceivable, but the recovery which occurs *in vivo* and *in vitro* and without experimental interference by such procedures as washing, etc., is to be designated as "pseudo-recovery," *i.e.*, restoration due to growth occurring in undamaged cells. Such recovery depends on the reproductive (*i.e.*, regenerative) power of the irradiated tissue, the dose of irradiation, the time in which this dose is given, and the blood supply of the tissue. There is a need of accurate information about the potency of recovery from radiation injury of the different basic tissues forming the human body.⁷

*Tissues most capable of recovery*⁸ are those with a high power of regeneration, *e.g.*, skin or testicles. The name "Mausergewebe" (molting tissue) has been proposed by Schinz (60) for this type of tissue.

Recovery of Organs: The organ in which recovery from radiation injury is best known is the *human skin*. In 1918 Krönig and Friedrich (35) showed that one erythema dose given in a single exposure was more effective than if one-thirteenth of this dose was given daily and repeated on thirteen successive days. This observation stimulated a long series of further experiments among which the work of Kingery (33), Pfahler (48, 49), Stenstrom and Mattick (67) may be mentioned. The results of their investigations made it possible to express recovery of the human skin from one skin unit dose in an exponential curve. The work of Reisner (58), MacComb and Quimby (43), and Quimby and MacComb (55) has completed our knowledge in this field. Using the threshold erythema as a test, they showed that the damaging effect of irradiation disappears at the rate of 36 per cent six hours after irradiation, and 50 per cent twelve hours later. If more than two irradiations were given daily, these values were valid only for the first interval. This indicates that there does not exist a constant daily recovery factor. Quimby and MacComb (55) published a table from

⁶ Similar conditions seem to be valid for irradiated cell-colonies, *e.g.*, bacteria (Drea, 5; Lea and co-workers, 39).

⁷ See Friedman (21).

⁸ There are some interesting attempts to express tissue recovery mathematically (31, 40, 55, 56).

which the accumulated dose in the skin could be calculated for any day during the period of treatment. The recovery of the skin can easily be explained as the result of the growth of the remaining undamaged cells and represents, therefore, what may be called "pseudo-recovery."

Another organ well known for its capacity of recovery from radiation injuries is the hair follicle. Here we are also dealing with an organ of high capacity for recuperation. The ability of hair to grow

16 per cent of the hairs growing in comparison with depilated but unirradiated control areas. But thirty days after irradiation, the number of hairs is up to about 75 per cent. It seems unlikely that the rapid regeneration can be explained by the formation of new hair, when it is remembered that the normal development of hair is about twelve to sixteen weeks." The work of Worning seems to prove a "true recovery" of hair from the effects of roentgen rays. We wish to lay stress on the

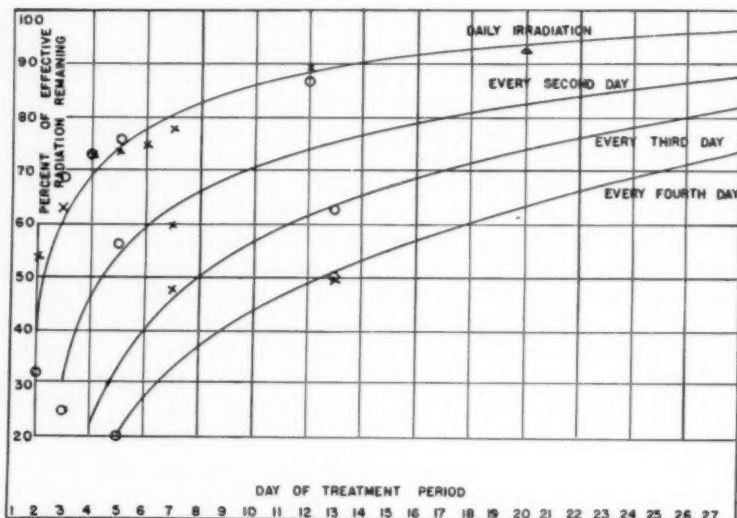


Fig. 3. Recovery of human skin from the effects of roentgen- or gamma-ray irradiation. Curves showing percentage of cumulative dose remaining at any time during treatment period: 200 kv. x-rays. (Courtesy of Dr. E. H. Quimby.)

again after epilation by roentgen rays finds extensive clinical application. In general the growth of hair is restored in eight to twelve weeks after administration of the so-called dose for temporary epilation. The question arises, whether the growth of hair after roentgen-ray epilation is due to ray-damaged cells which have recovered or to other cells which escaped damage. Worning (71) counted the number of growing hairs on guinea-pigs after epilation with barium sulphide powder and following irradiation. Having administered a dose which produced temporary epilation (900 r, H.V.L. 0.9 mm. Cu), he reported: "The effect, ten days after irradiation, is very marked, only

expression "seems to prove." We should, however, note other very important observations. Hance and Murphy (24) described the growth of white hair on colored mice in an area temporarily epilated by roentgen rays, an observation which subsequently has been confirmed in other quarters. The formation of white hair occurred also in Alaska rabbits, and here regrowing white hair was found also after epilation repeated up to five times (3). This is noteworthy because in these animals the formation of the hair pigment is known to take place on the surface of the mitochondria. The pigment disturbance of regrowing hair can, therefore, be located in

the mitochondria of the matrix cells. These experiments seem to show that hair growth in itself is not conclusive evidence of the absence of radiation injuries. The fact that hair growth after epilation does not always exhibit signs of damage does not indicate that the hair follicle is normal. However this may be, it seems likely that "true recovery" of hair from the effects of radiation can be regarded as questionable. Rather this would appear to be an example of a limited reversible effect.

Let us now consider the recovery of blood vessels from radiation effects. What is observed as recovery of blood vessels, especially of the capillaries of the skin, can be cited as a typical example of "pseudo-recovery," inasmuch as the alternate dilatation and contraction are due to the (indirect) action of break-down products formed in the destroyed cells in the area irradiated. (Lewis, 41; Ellinger, 10; Light, 42). There is no certain proof of real recovery of blood vessels which have undergone morphological changes.

From the morphologic point of view the leukoblastic tissues (spleen, lymph nodes, etc.) are known to be highly radiosensitive. Unfortunately, we have no knowledge about the dose of rays effecting irreversible changes. It is, therefore, difficult to give definite data concerning the recovery of these organs. Pohle and Bunting (51) have shown that the spleen of the rat is affected by a roentgen ray dose as small as 5 r, but even after 5,000 r the restitution of the malpighian bodies is completed after three days. This seems to be in agreement with what might be concluded from observation of the white blood count after exposure to roentgen rays. A drop in the number of white blood elements following irradiation was reported by Heineke in 1903. In agreement with earlier observations, Kornblum and associates (34) reported that five to eight weeks after exposure must elapse before the normal stage is reached. Regeneration of white blood cells depends to a great extent on the dose, the mode of administration (whether the dose is given in a single ses-



Fig. 4. Growth of white hair on a gray mouse in an area temporarily epilated by roentgen rays. The picture shows that growth in itself is not conclusive evidence of the absence of radiation injuries. (Courtesy of Dr. J. Murphy, Rockefeller Institute for Medical Research.)

sion or in fractionated doses), and the part of the body exposed (whether or not much of the lymphoblastic tissue is included in the irradiation field). The recovery of white blood cells is typical of what may be considered as "pseudo-recovery," since the regeneration is a matter of new formation of cells and depends only on the extent to which generative tissue has been damaged.

The further question arises as to whether or not regenerated white blood cells may be considered as normal in function. From the work of Kornblum and his associates (34) it can be concluded that blood cells newly formed after irradiation function properly. The authors found that injec-

tion of typhoid vaccine some months after cessation of irradiation meets with the characteristic response, though somewhat less marked than obtained in non-irradiated persons.

In comparison to the leukoblastic tissue, the erythroblastic tissue is relatively radio-resistant. The regenerative power of this tissue is considerable, so that even after heavy irradiation cell formation does not stop completely. The life cycle of erythrocytes is between twenty and thirty days (Regaud and Lacassagne, 57), and this time is sufficient to fill up the gap in production, so that no changes, or only unimportant ones, will be noted in the red blood count after that time.

Very interesting and of great clinical importance is the recovery of the testes from radiation injuries. Temporary sterilization is one of the earliest facts known about the biological action of roentgen rays. Schinz and Slotopolski (60) have given a detailed description of the histology of the irradiated rabbit testis. From their work it is evident that a dose of about 250 r diminishes the number of spermatogonia considerably, but a dose of at least 600 r is required to produce azoospermia lasting up to nine weeks (depending on the dose), and occurring after a latent period of three hours to four days. A dose of about 2,400 r, which also produced total epilation of the skin, resulted in permanent sterilization. In mice after exposure to 600–800 r there is, according to Snell (60a), "an initial fertile period which lasts about two weeks. Thereafter for a period of some weeks the males are sterile and during the latter part of this period spermatozoa are absent from the sperm ducts. About three months after x-raying, spermatozoa reappear in the vas deferens and animals again show normal fertility." In very interesting studies Ferroux, Regaud and Samssonow (18, 19) demonstrated similar conditions in rats: doses between 396 and 527 r produced azoospermia lasting up to three to five months, while for the production of permanent sterilization 2,215 to 3,318 r were required, a dose which resulted in permanent

injury to the skin. These data are consistent with the doses which produce temporary sterilization in man (about 250 r) and that for permanent sterilization—at least 600 r (12)—considering that the radioresistance of animal tissues is about three times that of human beings.⁹ The mechanism of the recovery of the testis consists, according to Schinz and Slotopolski (60), of an entirely new formation of spermatogonia growing out from Sertoli cells. *For these reasons the recovery of testicular tissue is a typical instance of "pseudo-recovery."*

Studying the problem of recovery of the ovaries, we must be aware that the mechanism of temporary sterilization in females is quite different from that in males. In the ovaries destruction of the ovum depends on its stage of development. In consequence, after one to three menstrual periods following exposure the human female may be sterilized for one to three years. After the expiration of this period menstruation is sometimes resumed. The interval between periods, which may at first be long, becomes shorter and shorter, until a normal cycle is reached. The reason for this is that not all ova are destroyed but only those near maturity are affected. During the period of amenorrhea primordial follicles undergo further development, and by this mechanism "recovery" from the injurious effect of radiation takes place. There is no doubt, therefore, that in the ovaries only "pseudo-recovery" occurs. It would be interesting to discuss whether or not, after temporary sterilization, spermatozoa and ova are to be considered as normal. This, however, would raise the question of genetic changes after irradiation which is beyond the scope of this paper.¹⁰

Observations of Pohle and Bunting (51) concerning the recovery of the liver are of clinical interest. Even when a dose of as much as 2,500 r was given, complete histologic recovery of the liver of rats occurred after thirty days. Recovery of the mucosa of trachea and esophagus of rabbits was

⁹ Derived from the skin tolerance dose.

¹⁰ For references see Ellinger (12).

reported by Engelstad (14), who described changes proceeding in waves. After a dose (given in one session) which left the skin untouched, recovery took place after three months. Using the same dose Engelstad (13) described the reaction of lung tissue appearing a few hours after irradiation, the changes here also proceeding in waves. After two months, restoration was noted, with only very slight production of connective tissue.

A problem of greatest clinical importance is the question of recovery of tumors from the injurious effects of radiation. Unfortunately our knowledge in this field is limited. Tissue culture work has shown that tumor tissue *in vitro* reacts to irradiation in the same manner as does normal tissue, even though there may be some difference in sensitivity (Prime, 53; Prime and Wood, 54; Laser and Halberstaedter, 38; Moppett, 44; Eidinow, 7; Spear, 64; Sugiura, 69; Sugiura and Cohen, 70; Goldfeder, 22). Therefore, from a theoretical point of view, recovery of tumors from injurious effects of radiation is also to be expected. This can easily be understood as "pseudo-recovery," since tumor tissue has a great regenerative power. The well known fact that some tumors become radioresistant after a certain amount of treatment seems to be a clinical evidence of "pseudo-recovery" of tumor tissue from radiation injuries, since the character of the tumor has definitely changed.

SUMMARY AND CONCLUSIONS

(1) The problem of recovery from effects of radiation has been discussed from the point of view of cellular physiology, photochemistry, and clinical application.

(2) To clarify the problem of recovery, "true recovery" has been designated the complete morphologic and functional restoration of single cells, while the term "pseudo-recovery" has been suggested for the restoration of organ function arising from growth of cells which have escaped radiation injury. "Pseudo-recovery," therefore, is the expression of the regenerative power of the tissue in question.

(3) "Clinical recovery" means restoration of organ structure and function and may include "true recovery" as well as "pseudo-recovery."

(4) An evaluation of experimental and clinical observations on recovery of single cells, tissues, and organs shows the difficulties in determining "true recovery" and demonstrates that most of the known facts are easily explainable by "pseudo-recovery."

(5) As long as we are not able to state exactly what part "true recovery" plays in the process of clinical restoration of organ structure and function after exposure to radiation, it seems advisable to consider "pseudo-recovery" as playing the principal role and to ascribe clinical recovery chiefly to the regenerative power of the tissues which form the irradiated organs.

(6) The evaluation of facts concerning "recovery" from radiation effects leads to the assumption that irradiation and surgical excision may act to a certain extent in the same manner.

(7) From the clinical point of view it seems advisable, therefore, to replace the term "recovery from radiation injuries" by the term "restoration from injurious effects of radiation," since the latter leaves open the mechanism of this process.

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A Multiple Cassette Changer for Angiocardiography: A Device for Rapid Serial Radiography¹

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CONTRAST radiography of the heart, or angiocardiography (1), is now a well established procedure from which insight may be gained regarding pathology of the cardiovascular system. For this examination a large quantity of concentrated dye (35 c.c. of 70 per cent diodrast) is rapidly injected into the brachial vein. Radiographs of the thorax taken immediately

graphs on 35-mm. film (2) are clearer than cineradiographs, but are definitely lacking in contrast. At present, satisfactory results can be obtained only by direct radiography. A 10 × 12-inch film appears to be necessary and adequate for this work. In order to obtain roentgenograms showing even one stage of the process, a number of exposures (at least six) must be made

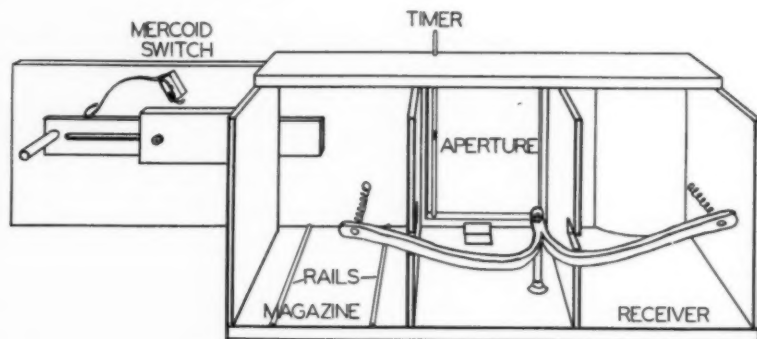


Fig. 1. Perspective view of apparatus from the rear.

thereafter show the contrast medium in its path through the heart and lungs. The changes in distribution of the contrast substance as it courses through the right auricle, right ventricle, pulmonary artery, lungs, left auricle, left ventricle, and finally the aorta, are quite rapid. The entire process is normally completed in less than ten seconds. Because of the normal and abnormal variations in the velocity of flow, the exact moment at which any particular chamber or vessel is reached cannot be predicted.

The obvious method of examination would be cineradiography. This method, however, suffers from a lack of detail and clarity and is therefore not extensively used for this purpose. Repeated fluoro-

all in a short time. The desired views may then be selected from this series.

Special apparatus is required to make possible the rapid successive exposure of films of this size. Recently a device for accomplishing this result has been described (3). It consists essentially of a large wheel with eight cassettes attached around the outer portion. The wheel is mounted behind a lead screen with an aperture through which one film at a time is exposed. The wheel is rotated between exposures through an angle just sufficient to bring the next film in place before the window. The apparatus is large and its operation somewhat unwieldy. Because of its size it has not been possible to make the height adjustable, a desirable feature in any device of this kind.

¹ Accepted for publication in August 1942.

The device here described accomplishes a similar result with the advantages of greater ease of operation, much reduced space requirements, and convenient mounting adjustable for height.

Figure 1 is a rear view of the apparatus. It consists essentially of three compartments arranged in a straight line: the magazine compartment, into which the cassettes (10 X 12 inch) are loaded, the exposure compartment, in which each film is exposed, and the receiver compartment, in which they accumulate. The front board of the device extends beyond these compartments to accommodate a thrust bar and a pivoted mercoid switch. This

At the front of the receiver compartment there is a curved clearance block firmly attached to the front board. Its function will be apparent later.

Figure 2 is a diagram of the apparatus in plan (top view) with the top board removed. Certain features are more clearly seen here than in Figure 1. The guide blocks and the curved clearance block at the right front of the receiver compartment are clearly visible. A fluoroscopic screen covered with lead glass (not shown in Fig. 1) is affixed over the rear of the aperture, behind the guide blocks. The spring lever is pivoted at a point in the exposure compartment and is arranged to

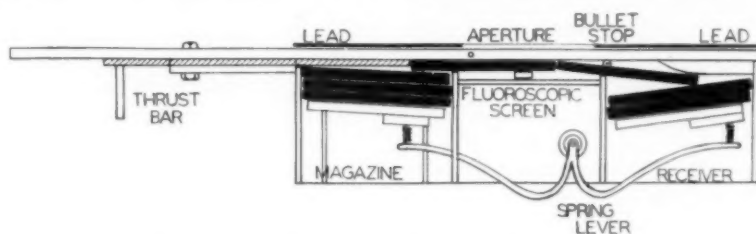


Fig. 2. Top view of apparatus, with the top board removed.

bar is slotted and moves through guides so arranged that its movement is limited at each extreme of its motion. The pivoted block for the mercoid switch bears a curved extension piece which rests on the thrust bar. When the thrust bar is pushed in all the way, the mercoid is tilted by the weight of the extension piece, so as to open its circuit. When the thrust bar is withdrawn, the mercoid contact closes. The connections to the mercoid contact are from the x-ray timer.

The base of the magazine compartment bears two metal rails mounted as indicated. The front board is covered with lead over the magazine and receiver compartments. An aperture is cut out in front of the exposure compartment. This aperture is closed by a thin cover of bakelite. A special type of timer, to be described below, is supported in the aperture as indicated. The spring lever and guide block seen in the exposure compartment will also be described more fully below.

exert pressure through pressure blocks (not shown in Fig. 1) upon the cassettes in the magazine and receiver compartments.

The operation of the device is as follows: The cassettes are stacked in the magazine compartment in front of the pressure block. With the device thus loaded, the patient is positioned with the help of the fluoroscopic screen. After the patient is in position, the controls are adjusted for radiography. The thrust bar is pushed in, pushing a cassette in position in front of the aperture. The contrast substance is now injected into the patient's vein.

Upon withdrawal of the thrust bar the pivoted mercoid switch closes the circuit, thus operating the x-ray timer and making an exposure. When the thrust bar is fully withdrawn, the spring pressure on the pile of cassettes in the magazine causes the pile to move forward along the metal rails, so that on the next inward thrust of the bar, another cassette is moved into

exposure position. This next cassette, in entering the exposure compartment, pushes the previous cassette into the receiver compartment.

Successive withdrawals and thrusts of the bar transfer cassettes from the magazine to the receiver. With each withdrawal an exposure is made; with each thrust a new cassette moves into place. Figure 2 shows the situation during the thrust movement following the third exposure. The cassette in the exposure aperture at the time of exposure is held in place by the guide blocks, and prevented from overriding by a small bullet stop. Clearance in the receiver compartment is assured by means of the curved clearance block which, together with the spring pressure, keeps the cassettes already in this compartment in position to permit the entrance of the next cassette.

Automatic operation of the device may be accomplished, if desired, by use of a motor, reducing gear, crank and connecting rod to drive the thrust bar.

The number of cassettes which may be accommodated depends upon the position of the fulcrum of the spring lever. This lever rotates about the fulcrum as cassettes are transferred from magazine to receiver, thus maintaining a reasonably constant pressure on both piles of cassettes. Its fulcrum could be made adjustable in position to take care of a variable number of cassettes. In the model we have constructed this feature is not incorporated and the fulcrum is fixed in position so that the device accommodates seven cassettes.

A simple timer has been incorporated in the device so that each film bears a record of the time of its exposure. The timer consists of an oil-filled glass tube containing a small iron pellet. The tube is withdrawn before operations begin and the pellet lifted to the top with a small

permanent magnet. The timer is then inserted into position and the pellet retained in place with the magnet or, alternatively, with an electromagnet. At the beginning of the injection the magnetic support is withdrawn either by pulling away the permanent magnet or by interrupting the circuit of the electromagnet. The pellet now falls through the oil at a regular rate determined by the viscosity of the oil and the sizes of the tube and pellet. The proper mixture of light machine oil and heavy mineral oil can easily be determined by trial to bring the rate of fall into the desired range. In our apparatus, at normal room temperature, the pellet drops at the rate of 2 cm. per second. Variations due to changes in temperature can be obviated by using special oils of low viscosity temperature coefficient. For angiocardiology this refinement appears to be clinically unnecessary.

Our apparatus is mounted on a "Century" studio camera stand providing easy adjustment for height. It has operated satisfactorily in spite of the fact that it is home-made and of relatively crude wooden construction. We have been able to take seven exposures in six seconds without difficulty. More finished construction ought to make possible an even greater speed, if desired.

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Clinico-Radiological Conference

HOSPITAL OF THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA, PENNA.

Karl Kornblum, M.D., Hobart A. Reimann, M.D., and Alison H. Price, M.D.

Dr. Price (presenting the case): A woman, F. C., aged 50, had a severe shivering chill lasting about twenty-five minutes on Dec. 20, 1941. Her temperature was then 38° C. (100.4° F.) and her leukocyte count 10,000. She was given a course of sulfadiazine therapy by her physician without effect. Later the temperature varied between 39 and 40° C. (102–104° F.), and there developed a dry, hacking, paroxysmal cough and profuse sweats requiring change of bed clothing. Chills recurred on three occasions.

The patient came to the hospital on the fifteenth day of her disease, with high fever, malaise, and cough. She appeared moderately sick; the temperature was 39.5° C. (103° F.), the pulse rate 95, and the respiration rate 24 per minute. Besides an unusual redness of the oral mucous membrane, a few tender cervical lymph nodes, and a small area in the right mammary region where a few seemingly unimportant râles were heard, there were no significant diagnostic features. The leukocytes numbered 6,800; the sedimentation rate was rapid, 34 mm. in twenty-five minutes; a blood culture was sterile. Tentative diagnoses of typhoid fever, tuberculosis, and rheumatic fever were made. On the following day a roentgenogram showed a surprisingly large, dense, homogeneous shadow in the lower portion of the right upper lobe suggesting lobar pneumonia. No abnormal physical signs were elicited over this area, and without roentgen study the extensive involvement would have been overlooked.

The temperature persisted at the high level of 39.5 to 40° C. (103 to 104° F.) until the twenty-second day, after which each successive swing was lower, and finally became normal on the twenty-ninth day. The pulse rate remained fairly constant at 100. The respiration rate rose from 22

to 30 on the twenty-second day. The leukocyte count never exceeded 10,000, and there was no unusual proportion of cells. Profuse sweating occurred at intervals until the nineteenth day, and a severe chill ensued the following day. Headache was severe during the second week, but there was only an occasional slight cough, without sputum, in spite of the striking shadows in the lung. Subsequent roentgenograms showed a further spread, then a melting of the density in the right upper lobe; on the twenty-third day the whole lower lobe became clouded, but never as densely as the upper. The shadows disappeared at four weeks. No abnormal physical signs except fine râles in the right mammary and axillary areas and in the right base posteriorly were ever heard.

CLINICAL DISCUSSION

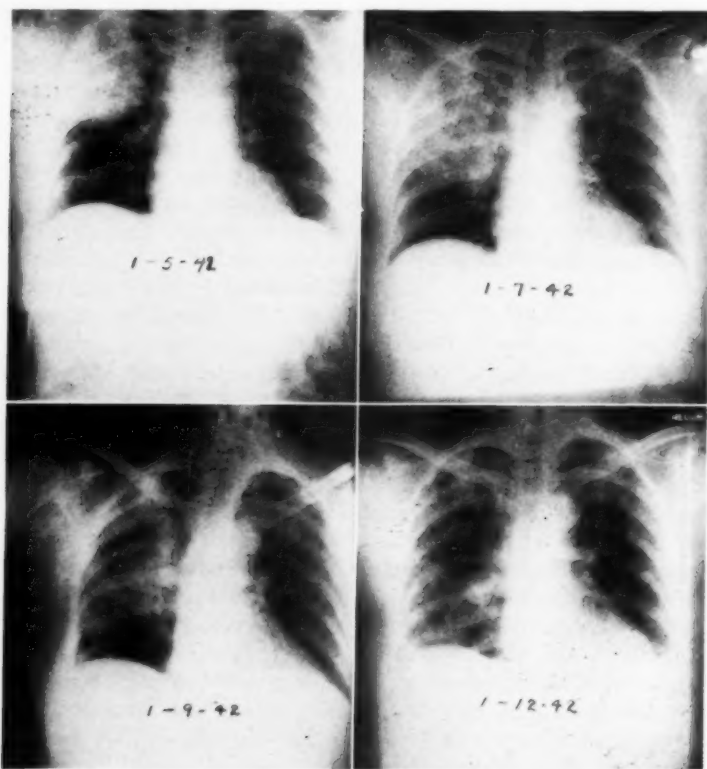
Dr. Reimann: When attention was first called to the large area of density in the lung, several diagnoses were considered. Although the opacity resembled that seen in pneumococcal lobar pneumonia, it was almost certain from a clinical standpoint that this was not the cause. Apart from the sudden onset in a previously well patient, the absence of response to sulfadiazine, the low leukocyte count, unproductive cough, sweating, recurrent chills, and bradycardia were against the diagnosis. Subsequently discovery of a mass in the pelvis suggested the possibility of a malignant growth with a metastatic tumor in the lung. The spread of the pulmonary shadow and its eventual fading, together with a careful pelvic examination, which revealed only a benign fibroid, excluded the diagnosis of neoplastic disease. A diagnosis of the newly recognized disease called "virus" or "viral" or "virus-like" pneumonia was then made. The complement-fixation test for psittacosis was per-

formed on the serum by Miss Margaret Wall of the Rockefeller Institute and gave the following results: twenty-third day of disease, titer 1:8; thirty-fifth day, 1:32; eight weeks, 1:256; twelve weeks, 1:128.

The rise and fall of the titer in early con-

have true psittacosis, since there was no history of contact with psittacine birds, and mice inoculated with sputum survived.

Final Diagnosis: Atypical (virus, viral) pneumonia probably caused by one of the viruses of the psittacine group.



Figs. 1-4. Successive roentgenograms of the chest, showing gradual clearing of the original lesion and spread to other areas.

valescence suggest that the disease was caused by one of the closely related viruses of the psittacine group, which includes psittacosis, a psittacosis-like disease (ornithosis), and lymphogranuloma venereum. The two latter newly recognized viruses are apparently widely spread among domestic animals and birds, such as pigeons, chickens, and mice. It is highly probable that these infections occasionally spread to man and from man to man and may give rise to the syndrome called "virus" pneumonia. The patient described did not

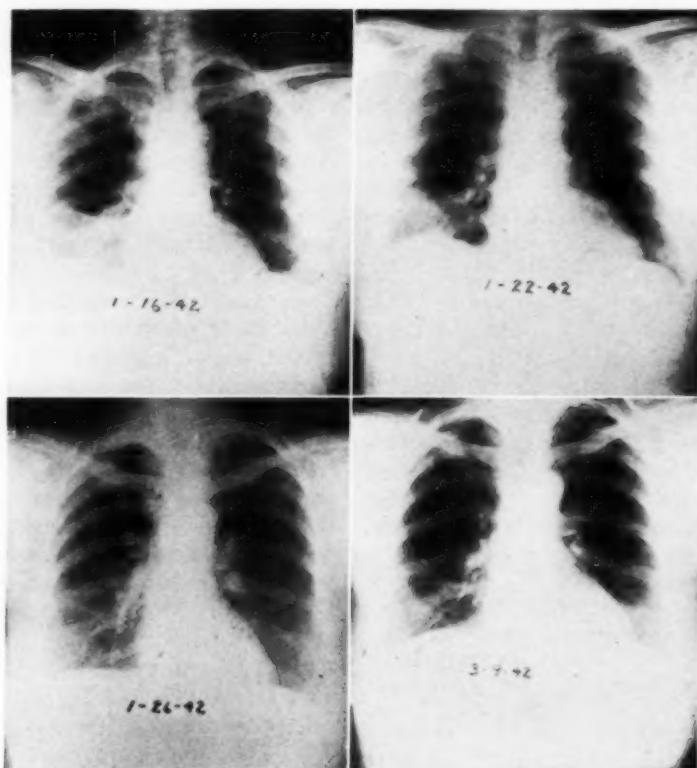
RADIOLOGIC DISCUSSION

Dr. Kornblum: The roentgenographic appearance of virus or virus-like pneumonia is by no means specifically characteristic, since its manifestations may be of such protean character. Roentgenographically, it is most likely to appear as an atypical, or so-called bronchopneumonia. At the onset of the disease, it may be unilateral, but is unlikely to remain so very long, showing a distinct tendency to become bilateral. There is nearly always an accentuation of the hilar

and trunk shadows indicative of an acute tracheobronchitis. A frequent accompaniment is a diffuse haziness of the lung fields with small mottled areas of increased density scattered throughout both lungs. While the roentgenogram may show a uni-

chyma of the lung is relatively common in this disease. It resembles or may be identical with the so-called influenzal pneumonia of some fifteen or twenty years ago.

The first roentgenogram of the chest of the patient under discussion, made Jan.



Figs. 5-8. Subsequent roentgenograms showing eventual return to normal.

form distribution, it is more common for involvement to be greater in one lung than the other. At times the disease starts as an isolated area of consolidation, of relatively small size, usually in the base of one lung. If such a lesion remains localized, although increasing in size, as it usually does, the appearance is quite typical of a pneumococcal lobar pneumonia. The initial lesion in the base, however, usually spreads upward to the hilum and the hilar region of the opposite lung then becomes involved. This bilateral hilar involvement with radiation outward into the paren-

5, 1942 (Fig. 1), the second hospital day, revealed a large area of consolidation occupying nearly the entire right upper lobe. The remainder of the right lung and the entire left lung were clear. In spite of the absence of clinical evidence, the possibility of a lobar pneumonia was suggested. The appearance was not that commonly seen in "virus" pneumonia. When the possibility of neoplastic disease was suggested by Dr. Reimann, it was admitted that a primary or secondary tumor could not be excluded, although the characteristics were more suggestive of an inflammatory process.

The second roentgenogram (Fig. 2) made two days later, Jan. 7, left little doubt as to the inflammatory nature of the lesion. As will be noted, the lesion has spread toward the right hilum and there is now evidence of a tracheobronchitis in the opposite lung.

In the third examination (Fig. 3), Jan. 9, clearing is taking place in the original site of involvement and the lesion continues to spread downward. There is now definite involvement in the hilar region of the left lung.

The fourth examination (Fig. 4), Jan. 12, shows that the lesion has spread to involve the entire right lung, being manifested by a hazy, mottled appearance throughout. The left lung is somewhat clearer than it was in the previous examination.

The fifth examination (Fig. 5), Jan. 16, revealed a decided change in that the upper portion of the right lung and the entire left lung had returned to normal but an area of consolidation was present in the right lower lobe, similar in appearance to the initial lesion in the right upper lobe.

The sixth examination (Fig. 6), Jan. 22,

showed the lesion in the right lower lobe undergoing resolution.

At the seventh examination (Fig. 7), Jan. 26, aside from a slight residual haziness in the right base, the chest was negative.

At the eighth examination (Fig. 8), March 9, the chest was negative.

The roentgen appearance of the pneumonia in this patient is rather typical of certain cases of "virus" pneumonia. In the early stage of the disease the true nature of the condition could not be recognized clinically or roentgenographically. The subsequent sequence of events, however, was diagnostic of this type of pneumonia.

It seems highly probable that many cases of atypical pneumonia are of virus origin, but in many the cause is still unknown. It is conceivable, but not very likely, that the variations in the roentgen manifestations may represent infection by different types of viruses. One would like to ascribe the type of lesion seen in the patient who forms the basis of this report to the psittacine group of viruses, but there is, of course, no basis for this assumption.



CASE REPORTS

Complete Compound Dislocation, Without Fracture, of the Distal Joint of the Ring Finger¹

D. D. SALMON, Captain, M.C., U.S.A

THE FOLLOWING case of complete compound dislocation of the middle phalanx upon the terminal phalanx of the right ring finger is thought to be of sufficient rarity and interest to warrant its report, especially as there was no associated fracture.

In reviewing the literature, in English, of the past five years, only 8 reports of compound dislocation unassociated with fracture have been found. Of the 8 cases recorded, only 1 involved a finger, in that case the thumb. The thumb is more susceptible to this type of injury because of its position away from the other fingers, which work together and act as a protection to one another. For this reason the ring finger is less liable to such an accident. Of the other cases reported in the recent literature, 6 involved the ankle and 1 the knee (1).

Hermann (1), in his discussion of the management of compound dislocations and fracture-dislocations, mentioned that in 19,291 cases obtained from the Boston City Hospital records for the period 1928 to 1937, inclusive, only 117 were compound fracture-dislocations, an incidence of 0.6 per cent. None of these was reported as a pure compound dislocation without associated fracture. Of an additional 2,374 cases in the year 1937 reviewed by Hermann, only 13 were of the compound dislocation or compound fracture-dislocation type, an incidence of 0.5 per cent. While this latter series is not subdivided into dislocations with and without fracture, one may assume that the latter constitute only a small fraction of the total incidence.

It has been suggested by Bell and Lockwood (2), Conwell and Aldredge (3),

Devine (4), Haines (5), North (6), and Penhallow (7) that these dislocations are produced by direct trauma, the direction of application of force being such that one articular surface of the joint is moved in a direction parallel with the other, which usually remains stationary. The resultant dislocation and compounding occur when the joint capsule ruptures without tearing away from its bony attachment and producing a chip fracture. If the capsule



Fig. 1. Compound dislocation of the ring finger, with protrusion of the head of the bone beyond the skin line and accumulation of air in the soft tissues.

were torn away from its attachments to the cancellous bone, it would seem probable that chips of bone could be seen on the x-ray film.

CASE REPORT

T. R., aged 25 years, white male, soldier, while playing soft ball was hit on the end of the ring finger of his right hand by the ball when he attempted to catch it. His finger was injured severely, the distal end of the middle phalanx protruding through the skin on the palmar surface of the finger, with ragged laceration of the skin edges. The patient did not show any evidence of shock and complained only of slight pain.

¹ Accepted for publication in August 1942.

Roentgenographic examination of the right ring finger (Fig. 1) revealed a compound dislocation of the distal interphalangeal joint, with the distal head of the middle phalanx protruding beyond the palmar surface of the skin, with no break in the continuity of either bone entering into the formation of this joint. There was an air bubble of moderate size in the soft tissue between the heads of the bones of the joint.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Robert Spencer Stone

In line of routine duty eight Canadian "Mounties" recently made the first west-to-east voyage through the Northwest Passage. They made it in a small 80-ton auxiliary schooner, and took two years and three months for the trip. When they landed on the Atlantic Coast not many weeks ago they neither expected, asked for, nor got leave. Sergeant Henry Larson, their leader, brushed aside compliments on the magnificent feat with the comment that other trips had been harder. We presume that Sergeant Larson was a Canadian; we know that our new President is one, and we like to think that he is made of the same kind of metal as the eight quiet heroes who casually completed such a difficult assignment.

Robert Spencer Stone was born in Chatham, Ontario, in 1895. He entered the University of Toronto in 1913, receiving his B.A. four years later in biology and physics. "Torontonensis" informs us that in the physics class of '17 he captured the hearts of all with his cheery smile and curly hair. We are happy to report that both pieces of equipment are still in good repair and daily use. Shortly after his graduation he joined the Royal Canadian Air Force and fought overseas in France. A bullet from the ubiquitous Boche brought him back to Canada in the year 1919.

From 1919 to 1921 he was on the Peking Medical School staff in China, as a teacher in anatomy. In 1922 he received his M.A. and in 1924 was graduated in medicine from Toronto. He served his internship in Grace Hospital, Detroit, and for two years practised

radiology in that city with his uncle, Dr. Rollin H. Stevens. In 1926 he went to San Francisco and commenced his distinguished career at the University of California Medical School as instructor in radiology under the late Howard Ruggles.

In 1934 Doctor Stone travelled across the United States with a few other intrepid radiologists, busily memorizing the definition of the roentgen and the depth dosage from a half-strength radium plaque when worn over an Eton collar. Partly as a result of this intensive refresher course on the train, he succeeded in passing the examination of the American Board of Radiology in the same year.

Doctor Stone's career as a clinical radiologist has been marked by fundamental and invaluable research into the comparative therapeutic effects of 200 and 1,000-kv. x-rays, of neutrons, and of various artificial radioactive materials. He has also contributed many memorable articles to the literature on diagnostic problems, notably some relating to difficult types of gastric and osseous lesions. His work has been marked by a thoroughness and candor rarely excelled. He has been more than cautious in evaluating new weapons and new technics in radiation therapy, knowing that the profession is all too prone to extol something new before it has been subjected to proper investigation. He has shown that the clinical results from million-volt therapy rarely exceed those obtainable with ordinary deep therapy, and, indeed, that the equipment of the radiation therapist's cranium is prone to be of much greater importance in the treatment of



ROBERT SPENCER STONE, M.D.
President of the Radiological Society of North America

neoplastic disease than the equipment of his department. Similarly, his conservatism has been of immense value in the early days of neutron and radiophosphorus therapy, and has helped to sober up enthusiastic claims for these amazing new biological research weapons.

In 1938 Doctor Stone was appointed full professor of radiology at the University of California, and two years later had the pleasure of seeing his department honored by identification as a separate division in the medical school.

He has won numerous scientific awards at various national and state radiological meetings for his exhibits and demonstrations, and he has been the invited guest lecturer on radiation therapy before academic groups throughout the country. Besides his numerous pedagogic and departmental duties, he has found time

to serve on the Executive Committee of the Pacific Roentgen Society for many years, on the Board of Directors of the San Francisco County Medical Society and, of course, on our own Board. He has maintained a keen and constructive interest in the organizational aspect of medical practice, knowing that the economic development of a specialty tends to be just as important and vital to its survival as the scientific. He is a botanist of no mean skill and will match his begonias with those of any other member—at least, after the war, when his garden has returned from utilitarian production to its pristine glory.

We are fortunate to have a man of Bob Stone's caliber in medicine and still more fortunate that he has been elected President of our Society. His honor is reflected in our own.—L. H. G.

Editorial Announcement

As one looks over the files of RADIOLOGY from Volume 1, published back in 1923, to Volume 39, just completed, he will note a considerable diversity of size. The first slender volumes contrast strangely with the ponderous tomes of 1931 and 1932. After these over-weight, over-size volumes comes a sudden fall to a few hundred pages and then a settling down to a uniform 780 pages or closely thereabouts. This latter size has seemed to the Publication Committee to approach the ideal—generous enough to permit of a considerable variety of papers and yet keeping each issue within usable dimensions, allowing emphasis on quality rather than on quantity.

In the face of seriously changed conditions, however, ideals must sometimes be temporarily modified. Realizing the importance of conserving to the utmost supplies of paper, metals, and labor, that the government may not be hampered in

its war efforts the Publication Committee has considered it the part of patriotism to set—for the present, at least—a new limit to the size of RADIOLOGY. In this connection, also, and in response to a request from the government for conservation of copper and zinc, our contributors are asked to limit their illustrations to the smallest number consistent with clarity. Each issue of RADIOLOGY will still be kept over 100 pages; the high standard of contributions will be maintained, and special attention will be given to the Abstract section, which with its comprehensive and timely survey of the world literature is in these crowded days more necessary than ever.

We assure our readers that, though temporarily shortened by a few pages, RADIOLOGY will continue to maintain its place in the front ranks of medical literature.

Refresher Courses

A little more than five years ago, at the Annual Meeting of the Radiological Society of North America in 1938, an innovation was introduced that has proved of unquestioned value and increasing popularity. This is the presentation of the Annual Refresher Series—a course of postgraduate instruction in subjects of fundamental concern to radiologists, given by outstanding men in the profession, and covering both theoretical and practical aspects of radiology. The high regard in which this feature of the Annual Meeting is held is attested by the large numbers registering each year for these courses.

It has seemed unfortunate that these presentations, prepared with such thought and containing such a wealth of material,

should not have some permanent form, for the sake both of those who attend the lectures and those who are prevented by circumstances from availing themselves of this opportunity. With this in mind, RADIOLOGY is presenting in the current issue one of these courses, "Diseases of the Mediastinum and Related Conditions," given by Lester W. Paul, M.D., in 1941 and again in 1942. It is hoped to follow this by others as space permits.

Reprints of the course appearing in this issue and of those that follow may be purchased through the business office so that those desiring to do so can assemble a series of monographs on various phases of radiology that should be of real value both for general reference and in teaching.



An Open Letter to Radiologists

The cornerstone of modern medical care is correct diagnosis, and the keystone of correct diagnosis is competent radiology. Competent radiology requires that there be adequate numbers of trained radiologists available both for patients outside hospitals and patients inside hospitals. As far as outside patients are concerned, there are fortunately hundreds of well trained conscientious radiologists in private practice who are doing good work and, as far as can now be told, will continue to do good independent American medical work in the future.

When we turn to the hospital situation the picture is somewhat different. There are hundreds of competent radiologists in American hospitals today, but many of them are *not* conducting their own practices. They have not the right to decide who shall be appointed as technicians and nurses in their departments, they cannot always decide the kind of equipment with which they must operate, and often they cannot decide the extent of the services which they believe they should render to patients, or the fees they should charge for those services. In other words, the departments of radiology are no longer under the direction of the radiologist in many hospitals—they are under the direction of the hospital superintendent.

If this were just a matter of fees or financial reward it might, with the altruistic traditions of the medical profession, well be overlooked. Obviously, however, it goes beyond that. He who pays the piper calls the tune. Precedents created today, especially in connection with group hospitalization insurance, may be frozen into our medical picture tomorrow.

What then should we do? The first and foremost obligation of every hospital

radiologist is to do good medical work and to see that in every manner possible he keeps radiology identified as a medical specialty, as a branch of medicine and not as a branch of hospital work. He should pay as much attention to the organization side of his department as he does to the scientific side. If he is indifferent, or too busy, or too lazy to attend to the organization side, he will find that in the eyes of the average layman, the average hospital superintendent, yes and even in the eyes of doctors, he is not in charge of his own department. More and more laymen and physicians are coming to regard radiology as a part of hospital service and not medical care. This is largely our own fault. (We are referring not to one or two large research or diagnostic clinics, but the average private hospital throughout the land.)

Again we ask what should be done about it? We would suggest that, for the sake of the scientific future of radiology in hospitals, as well as for the sake of the rights of the rest of our profession, we should not consent to the inclusion of our services in any formally organized hospital insurance scheme. This will require courageous action and constant vigilance. The radiologist cannot always control details of practice so far as ordinary hospital inpatients are concerned. When, however, a Blue Cross plan or a health insurance scheme gets started, the radiologist should go to his local county medical society and ask it not to approve any scheme that attempts to provide medical services (whether surgery or x-ray) as a part of hospitalization benefits, and, if they are already included, seek their exclusion or segregation. The crux of the Blue Cross plan problem is that many Blue Cross plans provide not group hospitalization, but hospitaliza-

tion plus diagnostic-medical care and in so providing will inevitably and ultimately control hospital radiology.

Think of it: ten million Americans are now covered by Blue Cross plans. In another decade twenty-five million Americans will be so covered. Diagnostic radiology benefits, instead of being limited to in-patients, will be extended to out-patients also. Why? To avoid abuse of hospital beds. Today, many subscribers *are* being hospitalized *only* because they are entitled to free x-ray services. By offering out-patient x-ray, the hospital will be able to reduce bed occupancy.

To reduce hospital costs further, more and more radiologists will be hired and fired on the basis of the lowest salary they will accept and not on their professional qualifications. The caliber of diagnostic medicine will suffer as the caliber of radiology declines.

Therefore, for purely scientific considerations alone, for the welfare of the specialty you have chosen, please awake to the vital necessity of having your service identified as a medical service, especially in Blue Cross plans. The present economic arrangements in medical practice have never come up for formal approval by a county or state medical society. But Blue Cross plans have. Observe that the American Medical Association has never approved a single Blue Cross plan. Why? Because the American Medical Association knows that if the Blue Cross plans can sell radiology today, and secure approval, they can sell surgery and ordinary medical care tomorrow, and demand approval. In no time they could control the entire practice of medicine. A group of laymen or corporations (always "not-for-profit") could dictate how and where medical practice should be conducted in this country.

Let us give group hospitalization our ardent support—when it *is* group hospitalization. There are today many communities, notably Kansas, Missouri, Washington, D. C., Michigan, Florida, and California, where radiology is either not

sold at all in connection with group hospitalization, or if sold is provided as a medical benefit along with, but not as a part of, hospital service. Checks for medical services are payable to medical men. Therefore, the group hospitalization corporation makes checks for radiology in hospitals payable to medical men. If they are on a salary or percentage basis they merely endorse the checks and turn them over to the hospital treasury. If they are on a lease or rental basis they deposit the checks to their accounts as would any other professional man. The importance of the distinction is exquisite. You are urged to ponder this problem and to take action now. You will be appalled to hear that some radiologists in one of our midwestern states have actually requested the local group hospitalization concern to make the checks payable to the hospital and not themselves. What incredible myopia!

Radiologists, please awake. Our number one problem is to win the war. Our number two problem is to prevent the destruction of scientific practice and of diagnostic medical care for generations to come. No layman, no Blue Cross director, can be expected to understand that radiology is the practice of medicine, and that you as radiologists have any professional rights whatever! You must tell them these things and tell them repeatedly. Just as all freedom-loving people have to fight for their freedom at regular intervals, almost every generation, so we, as members of the youngest and most rapidly developing specialty in medicine, have to fight for our own rights, and can proudly do so, knowing that we are fighting for the rest of medicine at the same time.

Ignoring entirely your own personal tastes in the matter and your own disregard for income, you should still awaken to the fact that the scientific side of your practice requires that it remain identified as a medical practice and not become a hospital one. So to identify it, you should collect your own fees and request all insurance companies, Blue Cross plans,

hospitalization companies, etc., to make checks for medical services payable to medical men, that is, checks for radiological services payable to radiologists. And by payment is meant the entire sum and not any artificial division of medicine or surgery into technical and professional. The surgeon performs many technical procedures in his work; yet it would be absurd and destructive of his practice if it were attempted to divide it into technical and professional. The same applies to

radiology. In the words of the American College of Surgeons, each doctor concerned in the care of a patient should give or send directly to the patient a detailed statement showing the charges for services rendered. Your colleagues in private practice do so today. Will you in your hospital practice seek likewise?

L. HENRY GARLAND, M.D., *Chairman*
Commission on Hospital Standards
American College of Radiology



RADIOLOGICAL SOCIETY OF NORTH AMERICA

TWENTY-EIGHTH ANNUAL MEETING, CHICAGO

Nov. 30-Dec. 4, 1942

SCIENTIFIC PROGRAM

Neither shortage of tires and gas nor crowded railroad trains could stop the Radiologists of North America from gathering to hear the splendid program, see the fine exhibits, attend the valuable refresher courses, and enjoy the delight of reunions at the 1942 meeting in Chicago. It is a tribute to the Local Committee, the Program Committee, our abused Secretary, and all concerned with the innumerable details, that over 750 went with confidence and left with satisfaction.

The meeting was formally opened on Monday morning by the President, Dr. Leon J. Menville, and a brief address of welcome was given by Dr. James E. Hutton, representing the Chicago Medical Society. The first paper was one on "Intussuscepting Lesions of the Small Intestine," by Dr. C. Allen Good of Rochester, Minn. He was followed by Dr. Charles W. Schwartz of New York, who was specially invited to speak on "Pitfalls to Be Avoided in the Roentgen Diagnosis of Intracranial Disease." The last paper of the morning was "Developmental Thinness of the Parietal Bones," by Dr. L. A. Nash and Dr. John D. Camp.

The first afternoon diagnostic session consisted of a timely symposium on Atypical Pneumonia arranged by Dr. Howard P. Doub. The papers and speakers were: "The Probable Incidence and Clinical Features of 'Virus' Pneumonia," Dr. Paul S. Rhoads; "Pathological Changes in So-Called Atypical Bronchopneumonia," Dr. Otto Saphir; "Primary Atypical Pneumonia of Unknown Origin," Lieut. Colonel P. V. McCarthy; "Primary Atypical Pneumonia of Unknown Etiology," Dr. Francis C. Curtzweiler and Major B. E. Moore; "Atypical Pneumonia of Probable Virus Origin," by Dr. C. E. Hufford and Dr. A. A. Applebaum. Three more papers were read: "Standards for Army Acceptance and Their Application as Illustrated by a Review of Fifty Thousand X-Ray Films of Inducted Men," Lieut. Colonel E. R. Long and Capt. W. H. Stearns; "Types of Pulmonary Tuberculosis Which Demand Disqualification for Active Duty in the Navy," Lieut. Commander C. H. Warfield; "Infected Cyst of the Lung," Dr. L. G. Rigler.

The Monday afternoon therapy session was chiefly occupied by a symposium on Carcinoma of the Cervix arranged by Dr. Edward Skinner. The speakers were: Doctor Skinner, "The History of the Treatment of Carcinoma of the Uterine Cervix"; Dr. Lewis C. Scheffey, Philadelphia, who spoke for the gynecologists, on "Experiences in the Treatment of Carcinoma of the Cervix"; Dr. LeRoy Sante,

"Further Experience with Pneumoperitoneum as an Aid in Pelvic Irradiation for Carcinoma of the Cervix"; Dr. Herbert Schmitz, "Further Study of Supervoltage X-Ray Therapy in Carcinoma of the Cervix"; Dr. W. W. Wasson, "Intravaginal X-Radiation of Malignancy of the Cervix"; Dr. M. Garcia, "Tissue Dosage in the Control of Carcinoma of the Cervix." Two further papers finished the afternoon program: "X-Ray Therapy in the United States Army," by Dr. John L. Barner, and "The Roentgen Therapy of Wilms' Tumor," by Dr. E. W. Rowe and Dr. M. D. Frazer.

Tuesday morning's session opened with "Observations on Venography of the Lower Extremities," by Dr. Edgar C. Baker, followed by a symposium on Tumor Clinics in General Hospitals, arranged by Dr. Erich Uhlmann and Dr. Robert Arens. The speakers were Dr. Bowman Crowell, Chicago; Dr. Louis C. Kress, Albany; Dr. John A. Wolfer, Chicago; Dr. George W. Holmes and Doctor Uhlmann. The morning was closed with "Classification and Filing in Department of Roentgenology—The Standard Nomenclature of Disease," by Stella Ford Walker, statistician, of Chicago.

The diagnostic session, Tuesday afternoon, opened with a paper entitled "Experimental and Clinical Myelography with Ethyl Iodophenylundecylate, Pantopaque" (you pronounce it, I spelled it), by Dr. T. B. Steinhausen, Dr. J. T. Plati, Dr. J. B. Furst, Dr. C. E. Dugan, Dr. S. W. Smith, Dr. S. L. Warren, and Dr. W. H. Strain, all of Rochester, N. Y. The paper indicated that this polysyllabic material would be an improvement on the opaque oils now in use. A symposium on the Correlation of Disability with Roentgen Findings, which was packed with useful information, followed. The papers were: "Head Injuries," Dr. Leslie Osmond; "Thoracic Injuries," Dr. Paul Bovard and Dr. J. W. G. Hannon; "The Spine," Dr. Forrest L. Schumacher, and "The Extremities," by Dr. Edgar Baker.

The therapeutic session of Tuesday opened with a paper on "Radium Treatment of Hypertrophied Lateral Bands of the Pharynx," by Dr. R. E. Fricke and Dr. P. N. Pastore. Among the other papers given on that afternoon were: "Radiation Therapy in Carcinoma of the Rectum and Sigmoid," Dr. E. A. Pohle, Dr. J. B. McAneny and Dr. B. K. Lovell; "Roentgen Therapy for Bronchogenic Carcinoma," Dr. E. T. Leddy; and "Giant Cell Tumors—Radiation Therapy—Late Results," by Dr. J. Gershon Cohen.



Doctor Menville, retiring president, hands on the Pfahler gavel to the incoming president, Doctor Stone.

The Carman Lecture was presented Tuesday evening by Dr. Eugene P. Pendergrass, whose subject was "Intravenous Urography as an Index of Kidney Function." The lecture and the lecturer were warmly received and both deserved it. Doctor Pendergrass filled the position in the high tradition of the man for whom the lecture is named, adding another example that will make it tough for future lecturers.

Wednesday morning opened with a blast of electrons from Dr. D. W. Kerst, Dr. H. W. Koch, and Dr. P. Morrison, of Urbana, Ill., entitled "The Betatron and Depth Dose Results up to 29 Million Volts," the blast being delivered by Doctor Kerst, whose little gadget sends electrons off at incredible speeds, in incredibly short times, to do incredible things. When you hear Doctor Kerst it sounds simple, but when you try to explain it to someone who wasn't there you get bogged down in a mass of vectors, which greatly increases your respect for Doctor Kerst and his co-workers. Seriously, this work opens up possibilities of vast scope and fundamental importance. We were extraordinarily privileged to have heard this paper.

The Wednesday afternoon diagnostic session consisted of a remarkably fine symposium arranged by Dr. Harry E. Mock of Chicago on Injuries of the Head, Chest and Back. The participants were: Doctor Mock, "Pertinent Facts Concerning Etiology, Diagnosis and Management of Head Injuries"; Dr. J. D. Kenning and Dr. I. D. Harris, "Roentgenologic Interpretations in Head Injuries"; Dr. F. W. Merrifield, "Management of Fractured Jaws"; Dr. J. P. Bennett, "Roentgenologic Diagnosis of Chest Injuries"; Dr. J. R. Head, "Diagnosis and Management of Chest Injuries"; Dr. E. J. Carey, "Anatomical and Physiological Considerations Prerequisite to Diagnosis of Back Trauma"; Dr. S. A. Morton, "Roentgenologic Diagnosis of Back Injuries"; Doctor Mock, "The Surgeon's Responsibility in Alleged Back Injuries."

The therapeutic section, on Wednesday afternoon, was opened by Dr. Edith Quimby with "Some Considerations Regarding the Teaching of Radiological Physics." Doctor Quimby was followed by Dr. J. M. Cork of Ann Arbor, with a paper on "Some Current Applications of Nuclear Physics," packed with interesting information and so spiced with wit that some of us wondered if a pun were not intended even in the title. Doctor Cork showed the most remarkable slide illustrating nuclear changes that we have had the privilege of seeing. There followed papers by Dr. Otto Glasser on "Protection in Contact Therapy," Dr. F. J. Hodges and



Doctor Stone pledges himself to the service of the Radiological Society as its new president.

I. Lampe on "The Differential Response of Tissues to Neutron Radiation," and Z. J. Atlee and E. D. Trout on "A Study of Roentgen Ray Distribution at 60-100 kv.p."

Thursday morning's general session consisted of three papers: "Roentgenologic Aspects of Acute and Chronic Esophagitis," Dr. Lester W. Paul; "Non-organic Gastric Filling Defects Simulating Carcinoma," Dr. Ed Jenkinson and Dr. K. K. Latteier; "The Roentgen Manifestations of Pleuro-Pulmonary Involvement in Tularemia," Dr. F. I. Bihss and Dr. H. I. Berland.

The diagnosticians, on Thursday afternoon, heard: Dr. A. J. Mellwain and Dr. J. R. Maxfield on "The Diagnostic Value of Pneumoperitoneum"; Dr. A. Brunswick and Dr. F. E. Templeton on "The Roentgenographic Diagnosis of Neoplasms of the Peri-Ampullary Region and Head of the Pancreas"; Dr. Samuel Brown, Dr. J. E. McCarthy and Dr. A. Fine on the "The Roentgen Diagnosis of Biliary Tract Tumors"; a stimulating paper by Dr. W. E. Reiley on "A Study of the Relation of Renal Ptosis and Gastro-intestinal Anomalies to Digestive Dis-



Honorary fellowship in the Society is bestowed by President Menville on Doctor Guzman of Chile and Doctor Caro of Argentina. Doctor Childs in the background.

turbances," and Dr. Harold Shinall on "Roentgen Diagnosis of Bronchogenic Carcinoma."

The therapists were treated to a panel discussion of the Treatment of Carcinoma of the Larynx arranged by Dr. Portmann and participated in by Dr. J. P. Simonds, Chicago, on pathology, Dr. Edwin C. Ernst on 200-kv. roentgen therapy, Dr. T. Leucuttia on 600-kv. therapy, Dr. Robert Stone on neutron therapy and Dr. Paul Hollinger on surgery. Four other papers on various subjects rounded out the afternoon.

The President's Banquet was held as usual on Thursday evening, and a delightful party it was. After partaking of cocktails as the guests of the Chicago Roentgen Society, and after consuming a rare treat for these days, fine juicy steaks, we settled down to a short program. Honorary fellowship in the Society was conferred by the President upon Dr. L. Guzman of Chile and Dr. David Caro of Argentina, who responded briefly. The new president-elect, Dr. Eldwin R. Witwer, of Detroit, was introduced, and the Pfahler gavel was presented by Doctor Menville to his successor in the presidency of the Society, Dr. Robert S. Stone of San Francisco. Lieut. Commander Chester H. Warfield spoke for the U. S. Navy; Lieut. Colonel Alfred A. deLorimier for the U. S. Army; Dr. Herman E. Hilleboe for the Public Health Service. The program was closed by our esteemed President, Doctor Menville, at his best. His inspiring address will appear in an early issue of RADIOLOGY.

The Friday morning sessions were well attended in spite of the festivities of the night before. We were treated to three fine papers: "A Stereoscopic Method for the Localization of Intraorbital Foreign Bodies," by Major Solomon Goldberg, Capt. E. P. Griffin, and Capt. Cesare Gianturco; "The Use of Small Film X-Ray in Tuberculosis Control," by Herman E. Hilleboe, Surgeon-in-Charge, Tuberculosis Control, U. S. Public Health

Service; and "Fluoride Osteosclerosis from Drinking Water," by Major Joseph F. Linsman and Major C. A. McMurray.

Because of unavoidable cancellations, the Friday afternoon diagnostic and therapeutic sessions were combined. The session was opened by Professor Guzman, of Santiago, Chile, speaking on "Granuloma Inguinale Associated with Carcinoma." The address was delivered in excellent English, which should give many of our North Americans red faces. Among other papers read on this last afternoon were: "Urinary Tract Changes Associated with Pelvic Tumors," by Dr. F. L. Payne and Dr. G. W. Chamberlin; "The Use of Basal Metabolic Rate in Regulation of Radiotherapy for Leukemia," by Dr. Erich Uhlmann and Dr. Martin Goldner; "Treatment of Osteogenic Sarcoma with Large



Doctor Menville delivers the president's address.

Doses of Pre-operative X-Radiation," by Dr. R. F. McNattin of Chicago.

No report of the meeting would be complete without mention of the discussants. It is too bad that they cannot take a bow individually, for they contributed much to the interest of the sessions.

This—our first wartime meeting—was in every way a success—in attendance, in the quality of the papers presented, and in the enthusiastic spirit manifested. Let us hope that we may meet next year to celebrate peace with victory and the assurance that the way of life which permits of such free interchange of ideas and experiences may continue unchallenged.

SYDNEY J. HAWLEY, M.D.

THE REFRESHER COURSES

The Annual Refresher Series again constituted one of the most important scientific features of the annual meeting of the Radiological Society of North America. The size of the group in each course was determined by the size of the room available, and most of the assigned rooms were filled to capacity, attesting the popularity of these educational courses, which covered a great variety of radiological subjects.

The panel discussions on Radiation Therapy, introduced at the San Francisco meeting, were continued and handled in the same manner as in 1941. These are definitely worth while and it was felt by many attending them that they should be continued. The first course, on "Diseases of the Esophagus, Stomach, and Duodenum," was presented by a clinical team from the Presbyterian Hospital, Chicago, which discussed their subject in its medical, surgical, gastroscopic, and roentgenologic aspects. A similar course was presented Sunday evening on the "Roentgenologic Diagnosis of Neurological Lesions" by a group from the University of Illinois College of Medicine, with Dr. Adolph Hartung presiding. Those who did not see and hear this course missed one of the best discussions of neurological lesions ever presented.

Dr. Robert S. Landauer, Ph.D., arranged the courses on Physics, which were presented on Sunday, Monday, Tuesday, and Wednesday. Those taking part were Otto Glasser, Ph.D., Robert Taft, M.D., Robert S. Landauer, Ph.D., J. L. Weatherman, M.A., Edith H. Quimby, Sc.D., and J. W. Stenstrom, Ph.D.

Other courses presented were: "A Study of the Gallbladder and Pancreas," by B. R. Kirklin, M.D., "Technic of Diagnosis of Duodenal Lesions by the Mucosal Relief Method," by F. E. Templeton, M.D., "Gastro-Intestinal Tract in Infants and Young Children," by William E. Anspach, M.D., "Radiology of the Small Intestines," by Harry Weber, M.D., and "Roentgen Differentiation of Abdominal Tumors," by Samuel Brown, M.D.

Courses on the chest were conducted on Monday, Tuesday, Wednesday, Thursday, and Friday by Leo G. Rigler, M.D., Howard P. Doub, M.D., W. Walter Wasson, M.D., Lester W. Paul, M.D., C. C. Birielso, M.D., Earl E. Barth, M.D., and Fred J. Hodges, M.D., who substituted for L. Henry Garland, M.D.

Other interesting courses were those on "Gynecography, Pneumoperitoneum and Hysterosalpingog-

raphy," given by Robert A. Arens, M.D., and Irving F. Stein, M.D.; "Aseptic Necrosis of Bone," by Paul C. Hodges, M.D., and Dallas B. Phemister, M.D.; "Differential Diagnosis of Bone Tumors," by John Murphy, M.D.; "The Intervertebral Disc," by Joseph C. Bell, Major, M.C.; "Low Back Pain," by Hollis E. Potter, M.D.; and "The Roentgenological Diagnosis of Intracranial Lesions," by Allen C. Good, M.D. As usual, "Roentgenology of the Urinary Tract" was ably handled and a full house was present for the discussion by Eugene P. Pendergrass, M.D., George W. Chamberlin, M.D., and P. Boland Hughes, M.D.

A course on the "Fundamental Principles of Protracted Fractional Radiation" was given by H. Dabney Kerr, M.D.; "Radiation Therapy of the Breast," by Lewis G. Allen, M.D.; "Radiation Treatment of Carcinoma of the Cervix," by Herbert E. Schmitz, M.D.; "Radiation Therapy of Carcinoma of the Uterine Fundus," by Robert E. Fricke, M.D., and "Treatment of Endocrine Dysfunction with Roentgen Rays," by Milton Friedman, Major, M.C.

The film-reading session Sunday evening, to which the members had been asked to bring films of proved cases, was exceptionally well attended. W. E. Chamberlain, M.D., presided, and was ably assisted by Fred J. Hodges, M.D., Earl E. Barth, M.D., Robert Stone, M.D., and Eugene P. Pendergrass, M.D. Many interesting cases were discussed.

The local committee cannot be too highly commended for the excellent manner in which they carried out the staging of these Refresher Courses. It made the work very simple; nothing was missing, and each instructor was able to start exactly on time. I wish to express my sincere gratitude to the committee, and especially to Lieut. Commander Earl E. Barth, U.S.N., and Benjamin D. Braun, M.D., for their careful and painstaking work.

I want also to express my appreciation to those members of the Chicago Medical Society who took part in the Refresher Courses, as well as to the local radiologists and to the men giving the courses, not only the radiologists but other members of the medical profession as well, and last but not least to those who took over the courses of men unable to attend. Especially do I want to express my appreciation to John Murphy, M.D., Fred J. Hodges, M.D., Herbert E. Schmitz, M.D., Harry Weber, M.D., and Allen C. Good, M.D.

IRA H. LOCKWOOD, M.D.

Chairman Refresher Course Committee

Attention is called to an important announcement having to do with the Refresher Courses, on page 84 of this issue.

THE SCIENTIFIC EXHIBITS

Kenneth D. A. Allen, Major, M. C., and Charles Wagner, Major, M. C. (Fitzsimons General Hospital, Denver, Colo.). **The Teaching of Army X-Ray Technicians:** This exhibit was of great interest from the military standpoint and showed to excellent advantage the teaching methods employed by Major Allen and his associates. It consisted of panels of photographs showing the physical facilities for teaching students; students at work in the department; special equipment employed as an adjunct to teaching; products of the student's work, such as motor, radiographs, etc.; products of the research department; a practical demonstration of army field equipment and its accessories.

Z. J. Atlee, B.S., and E. D. Trout, A.B. (Chicago, Ill.). **A Study of Roentgen Ray Distribution at 60-100 kv.p.:** Charts and diagrams demonstrated the variation and the distribution of the x-ray at relatively low voltages.

Edgar C. Baker, M.D. (Youngstown, Ohio). **Venography of the Lower Extremity:** This exhibit consisted of reproductions and reductions of venograms demonstrating anatomical patterns, as well as physiological observations made from serial films. The technical considerations were described briefly, and there were quite a number of reproductions showing the pathology observed. The technic is apparently not too difficult and in the hands of the exhibitor has been found interesting and reliable.

A. L. L. Bell, M.D., and George N. Edson, M.D. (Brooklyn, New York). **Characteristic Bone and Joint Changes in Compressed-Air Workers:** In this exhibit, which received the third award, films were displayed showing changes in various portions of the body in workers employed in a compressed air atmosphere. The extent and type of the involvement as differentiated from other conditions were demonstrated and many confusing conditions clarified.

J. de Carvajal-Forero, Ph.B., and Marvin R. Thompson, Ph.D. (New York, N. Y.). **Radiography of Soft Tissues by Monochromatic X-Radiation and Color Forming Developers:** Radiographs in color were shown, demonstrating soft tissues in proportion to their different densities without apparently sacrificing bone detail. According to the exhibitors, pathological conditions, such as varicose veins, the subcutaneous tissues, etc., can be clearly defined by this method.

A. A. de Lorimier, Lt. Col., M. C., Casper Epstein, Major, M. C., and Joe C. Rude, Major, M. C. (Army Medical School, Washington, D. C.). **Roentgenology of the Maxillo-Facial Bones:** This most instructive exhibit consisted of a display of photographs and films demonstrating fractures and lesions of the maxillofacial bones and mandible. In addition, Major de Lorimier presented a rather flexible localizing device that could be employed, with a very high degree of accuracy, in the localization of foreign bodies within the human body. This forms

an integral part of the x-ray table which Major de Lorimier has previously described. Portions of the apparatus could be readily removed for sterilization and reassembled.

Ernest P. Griffin, Jr., Captain, M. C., Cesare Gianturco, Captain, M. C., and Solomon Goldberg, Major, M. C. (LaGarde General Hospital, New Orleans, La.). **A Stereoscopic Method for the Localization of Intraorbital Foreign Bodies:** These exhibitors presented an apparatus for the localization of foreign bodies in the eye. The method consists of a stereoscopic projection of an artificial opaque eye onto a pair of stereoscopic films of the orbit, films of the orbit having been made in the same plane as that of the opaque eye. The method is simple and found to be reliable for persons with normal stereoscopic vision. This exhibit was awarded the second prize.

Adolph Hartung, M.D., Eric Oldberg, M.D., and T. J. Wachowski, M.D. (Chicago, Ill.). **Lesions of the Nervous System:** This exhibit consisted of film reductions showing both normal and pathological findings in the nervous system.

Charles Huggins, M.D., and William Thompson, B.S. (Chicago, Ill.). **Inhibition of Prostatic Cancer Metastases following Orchiectomy:** There were displayed x-ray films and protocols showing resolution of metastases, and one case showing resolution and subsequent recurrence, with a brief explanation of why orchiectomy produces resolution. Several cases were presented to show failure of response to orchiectomy, with an explanation as to why they were unsuccessful.

Herbert Lack, M.D. (Chicago, Ill.). **Congenital Hypertrophic Pyloric Stenosis:** This exhibit consisted of a description of the pathology, clinical signs, and roentgen appearance of tumor in congenital hypertrophic pyloric stenosis before and after surgery. Also included were descriptions of the technic employed in the examination of the infant's stomach and of the normal appearance of this structure.

Joseph J. Litschgi, M.D. (Chicago, Ill.). **Plastography in Roentgen Diagnosis:** Plastography is an application of a photographic form of bas-relief to x-ray negatives to enhance diagnostic qualities. Bas-relief is a type of relief sculpture in which the design is slightly raised from the background and produces an illusion of three dimensions, through practically a two-dimensional medium. In art, it has been used photographically by manipulating a positive with its negative to give a similar effect. While not a true stereo, it does intensify and render more graphic the diagnostic qualities of a radiograph.

Ira H. Lockwood, M.D., and Arthur B. Smith, Lieut., M. C. (Kansas City, Mo.). **Malignant Tumors of the Gastro-Intestinal Tract:** This exhibit consisted of a radiographic study of a series of malignant neoplasms of the gastro-intestinal tract, with history, photographic, and photomicrographic correlation of the findings.

Russell H. Morgan, M.D. (Chicago, Ill.). An Exposure Meter for Use in Radiography: Doctor Morgan's exhibit consisted of two parts. The first was an exposure meter, which, in the opinion of the Committee on Awards, was the outstanding contribution in the Scientific Exhibition, and for which Doctor Morgan was awarded the first prize. The details of construction are quite technical and cannot be adequately covered here.

The second portion of the exhibit consisted of a series of films showing the constancy of the average density of films taken with the exposure meter as compared with films taken according to methods generally employed. Included in the exhibit was a series of roentgenograms of the chest demonstrating the effect of variation in kilovoltage when the exposure meter was used.

Russell H. Morgan, M.D. (Chicago, Ill.). A Motor-Driven Potter-Bucky Grid Providing Continuous Motion: A motor-driven Potter-Bucky grid was demonstrated, which moved continuously in a to-and-fro motion and at a constant speed across a film. The device was entirely automatic in its operation and required no cocking or other adjustments. A series of films demonstrating the quality of roentgenograms made with the instrument as compared with those made with the standard Potter-Bucky grid was also shown.

L. W. Paul, M.D., and E. A. Pohle, M.D., Ph.D. (Madison, Wis.). Radiation Osteitis of the Ribs: Following roentgen irradiation to the chest wall after mastectomy for carcinoma of the breast, changes have been observed in the underlying ribs which appeared to be due to radiation osteitis. The major manifestation of this process has been painless fractures of one or more (usually multiple) ribs. Non-union of these fractures has been the rule. The roentgen diagnostic aspects and the differential diagnosis, particularly with reference to metastatic involvement of the ribs, were stressed.

Gerhart Schwarz, M.D. (Chicago, Ill.). The Phrenic Ampulla: The phrenic ampulla is said to be a fusiform expansion of the lowermost (supradiaphragmatic) segment of the esophagus. Described by the older anatomists, it escaped the attention of many of the more recent authors. It was apt to be mistaken for a hiatus hernia. Some differential

diagnostic points were discussed.

Wendell P. Stampfli, M.D. (Chicago, Ill.). "Curling" of the Esophagus: This exhibit consisted of the definition of "curling"; films demonstrating normal esophageal movements; films demonstrating the "curling" phenomenon; considerations as to incidence and relation to symptoms, and presentation of four autopsied cases.

Paul C. Swenson, M.D. and A. Purdy Stout, M.D. (by invitation) (New York, N. Y.). Roentgenology and Pathology of Ewing's Tumor: This exhibit consisted of many roentgenograms, photographs, and discussions regarding the differential diagnosis of Ewing's tumor. There is no typical finding from the x-ray standpoint in Ewing's tumor and there is no correlation between the histological variations and the x-ray film. The authors conclude that it is impossible in many cases to make a diagnosis of Ewing's tumor without biopsy.

Robert B. Taft, M.D. (Charleston, S. C.). Ionization Oscillograms: A single-stage amplifier developed by the exhibitor has sufficient sensitivity to take the ionization current from a thimble chamber and show its fluctuations on the screen of the cathode-ray oscillograph. Photographs of the screen are believed to be true time-intensity curves of the radiation output. Curves were shown on charts and the apparatus was activated by a small portable x-ray machine.

Frederic E. Templeton, M.D., and Richard A. Kredel, M.D. (Chicago, Ill.). Pharyngo-esophageal Junction: The pharynx and pharyngo-esophageal junction are studied by observing the pharynx under the fluoroscope and recording films during the passage of barium through the pharynx. Particular emphasis was placed on the use of the Valsalva test for demonstration of the cricopharyngeus muscle. Technic of examination was given, and normal and abnormal conditions were illustrated.

Carl A. W. Zimmermann, M.D. (Cape Girardeau, Missouri). (A) Osteopetrosis (Albers-Schönberg's Disease): Showing some unusual features and stressing some others. (B) A Case of Volvulus of the Stomach, not associated with diaphragmatic hernia, but with a displaced spleen.

ELDWIN R. WITWER, M.D.

THE TECHNICAL EXHIBITS

The beautiful and spacious Gold Coast Room of the Drake Hotel, Chicago, was this year the location of twenty technical displays of great interest to radiologists. Both side walls and a large center section of this room were taken up by the exhibits.

In spite of present conditions the number of exhibitors was only one less than at the 1941 meeting in San Francisco, just before the United States entered the war. A patriotic motif predominated, varying all the way from an illuminated V, on which one exhibitor had listed the names of employees in the service, to the showing of complete x-ray units developed especially for work on the field of battle. Uniforms were numerous among the visitors to the exhibits, reminding one of the seriousness of war and demonstrating the co-operation of our Society members with the armed forces.

It is impossible to describe adequately the various exhibits, but a short résumé of each will give at least a little information to those who were unable to attend and let them know something of what they missed. Although much apparatus is "frozen" by General Limitation Order No. L-206, it is believed that those who require new or replacement equipment will have little difficulty in obtaining approval of their application from the War Production Board if conditions warrant the purchase.

Agfa Ansco (Binghamton, N. Y.): An entirely new type of improved x-ray processing chemicals was offered by Agfa Ansco for the approval of radiologists. These chemicals are said to combine the advantages of speed, long life, and superior keeping qualities. They are of the concentrated liquid, easy-to-mix type. Specimen roentgenograms on high-speed and on non-screen film were shown. Much interest was occasioned by the Agfa direct duplicating film and by new films for industrial radiographic requirements.

Canadian Radium and Uranium Corporation (630 Fifth Ave., New York, N. Y.): Considerable interest was aroused by a chunk of radioactive ore from the mines at Great Bear Lake, demonstrated by Mr. R. M. Corbett, who advised us that his company is the only active producer of radium in the world at present. Radium containers, radium accessory equipment and testing instruments were shown and the use of radium in making industrial radiographs was described.

Eastman Kodak Company (Rochester, N. Y.): demonstrated Blue Brand and "No-Screen" films, as well as showing Kotavachrome prints and Kodachrome transparencies. The use of these color methods for presenting clinical material is of increasing importance. Mr. Fred Martin acted as master of ceremonies at the Eastman booth, as in the past—and, we hope, in the future.

E. I. du Pont de Nemours & Co. (Wilmington, Del.): The du Pont slogan—"Better Things for

Better Living—through Chemistry" was well demonstrated by the Company's exhibit. Unusual and interesting roentgenograms made with du Pont films and chemicals were shown, and the special features of du Pont products were enlarged upon by Mr. E. R. Owen and his associates.

Eureka X-Ray Tube Corporation (3240-58 North Kilpatrick Ave., Chicago, Ill.) brought out their new S.P. 3 advanced design shockproof, oil-immersed 120 kv.p. x-ray tube for roentgenography, fluoroscopy, and superficial therapy. This tube has an especially high heat storage capacity and was the object of much interest.

General Electric X-Ray Corporation (2012 Jackson Blvd., Chicago, Ill.): The background of the G.E. exhibit was formed by ten large illuminated panels illustrating various G.E. products and services and showing developments in x-ray that began primarily as of interest to the physician but have developed into important factors in the war effort. A photoroentgen unit for making 4×5 " stereo pairs and the viewing stereoscope were demonstrated. Supermix chemicals and other accessories were shown. As usual, the host at the G.E. exhibit was the hospitable "Connie" Wantz. Without Connie a G.E. exhibit would be definitely lacking.

The Kelley-Koett Mfg. Co. (Covington, Ky.): The Kelley-Koett exhibit placed special emphasis on co-operation with the war effort by advising periodic inspection and repair of equipment in order to prevent major delays and breakdowns. An extensive collection of accessories, including tubes, eye localizers, spot film devices, etc., made many of the visitors to this exhibit decide on additional "must" items for their laboratories.

Lea & Febiger, Publishers (Washington Square, Philadelphia, Penna.): Of special interest in this comprehensive exhibit of medical books was the enlarged second edition of Master's "The Electrocardiogram and X-Ray Configuration of the Heart," a complete atlas of heart roentgenograms which ties together the electrocardiographic and roentgen findings. "Roentgen Treatment of Diseases of the Nervous System," by Dyke and Davidoff also drew considerable attention.

Liebel-Flarsheim Co. (303 West Third St., Cincinnati, Ohio) displayed their line of filter grids and x-ray timers. The latter included a radiographic timer for times as short as 1/10 sec., accurate to 1/120 sec., and a precision therapy timer for any settings up to 55 min., accurate to 1/10 sec.

Machlett Laboratories, Inc. (Springdale, Conn.) centered their display around their new Dynamax "25" diagnostic shock-proof rotating anode tube, which has a greatly improved heat radiating capacity, and which, with a small attached air blower, permits of double the usual number of exposures at rapid intervals. An improved x-ray tube for diffraction analysis, for use in industry, was also shown.

F. Mattern Mfg. Co. (4647 North Cicero Ave., Chicago, Ill.): A 200-milliampere (U. S. Army), fluoroscopic and radiographic tilt-table set-up, as well as a U. S. Navy mobile unit, was demonstrated to many visitors. The Navy unit was very compact, fitting into three cases. Also demonstrated were a 140-kv. water-cooled therapy layout with a Thermax tube. The new 200-ma., 100-kv. diagnostic equipment with rotating anode tube attracted favorable comment.

C. V. Mosby Company (3517-29 Pine Blvd., St. Louis, Mo.) had a large display of the latest medical books. Of particular interest was Clark's "Positioning in Radiography," "Cancer of the Face and Mouth," by Blair, Moore, and Byars, and the fifth edition of Bertwistle's "Descriptive Atlas of Radiographs."

The Patterson Screen Company (Towanda, Penna.): The Patterson booth was a meeting place for many to renew old friendships and to secure the latest advice from Fred Reuter on how to make your intensifying screens last to a good old age. If you are not up on the proper care of intensifying screens, drop Fred a postcard.

Philips Metalix Corporation (419 Fourth Ave., New York, N. Y.) displayed their apparatus for Chaoul contact therapy, a comparatively recent technic which is attracting continually increasing attention. They also demonstrated a hospital cart, with an adjustable Bucky with laminated wooden tops for radiography—or fluoroscopy—without the necessity of removing the patient from the cart.

Picker X-Ray Corporation (300 Fourth Ave., New York, N. Y.): The Picker exhibit was presided over by no less a person than the genial Mr. Picker, Sr., himself. Everyone was happy to see the Army-Navy "E" banner displayed at this booth, and we congratulate Mr. Picker and his staff on this award for outstanding results in war production. Although figures on production are, of course, not available, a recent newspaper article stated that more than 3,000 Picker x-ray units had been delivered to the U. S. Army, while several hundred had been sent to Russia.

The Army Air Corps unit, which has been praised by Lieut. Gen. Dwight E. Eisenhower for its front-line service in North Africa, developed especially for transport by plane, packs into three compact cases and weighs only 399 pounds packed. It is used for fluoroscopy, localizations, and radiography. A somewhat larger Picker unit, the U. S. Army Field unit (mobile), weighs 620 pounds packed and also breaks up into several small cases for shipping. The

unit is of use not only in fluoroscopy and radiography but also for superficial therapy. In addition the Picker exhibit included an extensive line of chemicals and accessories.

Radium Chemical Company, Inc. (570 Lexington Ave., New York, N. Y.) exhibited a complete line of radium- and radon-handling equipment, including new and unusual devices for applying radium or radon in gynecologic fields. All-gold radon implants, as well as platinum needles, tubes, and cells for radium applications were shown. No government priorities are required for radium for medical uses, and prompt deliveries on radium were assured.

Standard X-Ray Company (1932-42 N. Burling St., Chicago, Ill.) exhibited its new Flexray deep therapy tube stand, which is an unusually flexible and easily manipulated apparatus for 220-kv. therapy. They also showed their combination mobile and portable x-ray unit. Both of these pieces of apparatus were centers of attention and many favorable comments were heard.

Charles C. Thomas, Publisher (220 E. Monroe St., Springfield, Ill.) presented an interesting display of books and periodicals. Among the many items shown, the second printing of "The Head and Neck in Roentgen Diagnosis," by Pancoast, Pendergrass, and Schaeffer, identical with the first printing, but at a substantially lower price, was a favorite purchase.

The Victoreen Instrument Company (5806 Hough Ave., Cleveland, Ohio): In line with the slogan which it frequently uses—"Knowledge Is Your Protection"—the Victoreen Company demonstrated the latest models of roentgen-measuring instruments. In addition to their well known condenser r-meter, they displayed the minometer, which makes it possible to compute the daily amount of radiation absorbed by a physician or to check up on stray radiation in medical procedures and industrial applications.

Westinghouse Electric & Mfg. Co. (East Pittsburgh, Penna.), highlighted the X-Actron, an automatic electron filament control, which eliminates the conventional filament control from the control panel. A portable photofluorographic unit developed for examinations of chests at induction centers and for public health surveys, and the U. S. Army processing tank which, though easily portable, incorporates heating or/and cooling of the water, attracted much interest. When the war is over this type of tank may prove to be the answer to many a dark room remodeling problem.

WALTER R. SCOTT, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN BOARD OF RADIOLOGY EXAMINATIONS

The Board of Trustees of The American Board of Radiology has decided to continue examinations during the emergency and will therefore conduct an examination during April, May, or June of 1943. An attempt will be made to hold the examination at a place most convenient to the majority of the candidates.

Those wishing to be examined at the spring examination must have their application on file by March 1. Address all communications to Dr. B. R. Kirklin, Secretary, The American Board of Radiology, Mayo Clinic, Rochester, Minnesota.

ANNUAL MEETING AMERICAN COLLEGE OF PHYSICIANS

The Board of Regents of the American College of Physicians has announced the cancellation of the 1943 Annual Session, which was scheduled to be held in Philadelphia, April 13-16, 1943.

AMERICAN UROLOGICAL ASSOCIATION UROLOGY AWARD

The American Urological Association offers an annual award, "not to exceed \$500," for an essay (or essays) on the result of some specific clinical or laboratory research in Urology. The amount of the prize is based on the merits of the work presented, and if the Committee on Scientific Research deems none of the offerings worthy, no award will be made. Competitors shall be limited to residents in urology in recognized hospitals and to urologists who have been in such specific practice for not more than five years.

The selected essay (or essays) for the current year will appear on the program of the forthcoming meeting of the American Urological Association, May 31-June 3, 1943, Hotel Jefferson, St. Louis, Missouri.

Essays must be in the hands of the Secretary, Dr. Thomas D. Moore, 899 Madison Avenue, Memphis, Tennessee, on or before March 1, 1943.

SPRING MEETING MIDWESTERN RADIOLOGISTS

It has been decided to cancel the meeting of the Midwestern Radiologists, which was to have been held in Cleveland, Ohio, in the spring of 1943.

In Memoriam

HARRY H. HEYLMUN, M.D. 1868-1942

Dr. Harry H. Heylmun of Long Beach, Calif., died on Oct. 30, 1942.

Doctor Heylmun was born in Williamsport, Penna., seventy-four years ago, and was graduated in 1897 from the Kansas City Medical College. Prior to his specialization in diagnostic radiology, he practised general medicine and surgery with



HARRY H. HEYLMUN, M.D.

notable success in the Middle West. He continued his interest in the broader fields of medicine throughout his life, and thus developed a singular ability to translate his radiographic impressions into clinical and pathological concepts. In 1915, he established his practice in x-ray diagnosis in Long Beach, California. Still active, despite advancing years and failing health, he continued his work until the onset of his final illness.

Doctor Heylmun established the Department of Radiology at Seaside Hospital and for many years was its director. He was a diplomate of the American Board of Radiology, a member of the American College of Radiology, and a member of the Radiological Society of North America.

WALTER C. SMALLWOOD, M.D.

WILLIAM MARTIN SHERIDAN, M.D.
1896-1942

Dr. Wm. M. Sheridan, of Spartanburg, S. C., died on Oct. 30. Doctor Sheridan was graduated from Jefferson Medical College in 1921 and was on the staff of the Spartanburg General Hospital. He was a diplomate of the American Board of Radiology and a member of the College of Radiology and the Radiological Society of North America.

ERIC LILJENCRA NTZ

COMMANDER, M.C., U. S. NAVAL RESERVE
1902-1942

Commander Eric Liljencrantz of the U. S. Naval Reserve was killed in an airplane accident, while on active duty at sea, on Nov. 5. Commander Liljencrantz was born in Oakland, California. He was graduated in 1929 from Stanford University Medical School and was assistant professor of medicine (radiology) there from 1934 until the time of his death. He was certified by the American Board of Radiology and was a member of the American College of Radiology. Commander Liljencrantz was interested also in problems of aviation medicine and had only recently been appointed director of the proposed Aeromedical Research Laboratory.

Books Received

ROENTGEN TREATMENT OF DISEASES OF THE NERVOUS SYSTEM. By CORNELIUS G. DYKE, M.D., F.A.C.R., Associate Professor of Radiology, College of Physicians and Surgeons, Columbia University; Director, Department of Radiology, Neurological Institute of New York, and LEO M. DAVIDOFF, M.D., F.A.C.S., Chief, Department of Surgery, Attending Neurological Surgeon, Jewish Hospital of Brooklyn. A volume of 198 pages, with 12 engravings, 7 charts, and 16 graphs. Published by Lea & Febiger, Philadelphia, 1942. Price \$3.25.

CHANGES IN THE KNEE JOINT AT VARIOUS AGES, WITH PARTICULAR REFERENCE TO THE NATURE AND DEVELOPMENT OF DEGENERATIVE JOINT DISEASE. By GRANVILLE A. BENNETT, M.D., Associate Professor of Pathology, Harvard Medical School., HANS WAINE, M.D., Research Fellow in Medicine, Harvard Medical School, Graduate Assistant in Medicine, Massachusetts General Hospital, and WALTER BAUER, M.D., Associate Professor in Medicine, Harvard Medical School; Physician to the Massachusetts General Hospital;

Director, Robert W. Lovett Memorial Foundation for the Study of Crippling Diseases. A volume of 97 pages with 31 plates. Published by The Commonwealth Fund, New York, 1942. Price \$2.50.

Book Review

TRAUMATIC SURGERY OF THE JAWS INCLUDING FIRST-AID TREATMENT. By KURT H. THOMA, D.M.D. A volume of 315 pages with 282 illustrations. Published by C. V. Mosby Company, St. Louis, 1942. Price \$6.00.

This is a compact, well written book designed to aid the dentist or physician in applying proper methods in the treatment of fractures of the jaws. It has an abundance of excellent illustrations, which assist materially in the interpretation of the text. Since the book was compiled to provide assistance to those called on to treat fractures of the jaws in connection with military service, there is included a brief but excellent outline of measures to be used in first-aid treatment to combat shock and hemorrhage and to provide emergency nutrition.

The author has well stated, in his opening paragraph: "Injuries of the jaws require highly specialized technical treatment which is directed toward the establishment of normal function of the jaws and teeth." He has added the further pertinent comment: "Hastily undertaken procedures are often harmful, and nothing is lost by waiting a few days, especially if any risk is involved in moving the patient on account of his general condition." Emphasis is very properly placed on the selection of a simple and adequate technic. "The method of fixation selected should be the simplest one which will give good results, and good functional results can only be obtained if the fracture heals so that the teeth are in normal occlusion." The accepted methods of treatment are well described and illustrated. The author believes that a more extensive use than formerly will be made of skeletal fixation in the management of fractures of the jaws and accordingly has described and illustrated various methods.

Authorities disagree as to the best procedure to be followed in the management of fractures of the condylar process of the mandible. Doctor Thoma presents both sides of the case and explains his own point of view, which is that sometimes one method should be followed and sometimes another.

This book will find its place and will unquestionably provide much needed help for those working in the field which it covers.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please co-operate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Earl R. Miller, M.D., University of California Hospital. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (University of California Medical School); second six months at Lane Hall (Stanford University School of Medicine).

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, W. R. Harwell, M.D. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—Secretary, Hugh F. Hare, M.D., Labey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Maurice Pomeranz, M.D., 1120 Park Ave., New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, J. O. Newton, M.D., 13921 Terrace Road, East Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, L. W. Baird, M.D., Scott and White Hospital, Temple.

VIRGINIA

Virginia Radiological Society.—Secretary, Charles H. Peterson, M.D., 603 Medical Arts Bldg., Roanoke.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Ontario Medical Association.—Secretary, W. J. Cryderman, M.D., 474 Glenlake Avenue, Toronto.

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Électrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Calcified Tuberculoma of the Brain. L. M. Weinberger and F. C. Grant. *Am. J. Roentgenol.* 47: 525-533, April 1942.

Only 19 verified cases of calcified tuberculoma of the brain have been reported. Ten of these were discovered at autopsy and 9 were an unsuspected operative finding. The authors report an additional case, in which the diagnosis was suspected on roentgen examination of the skull and verified at operation. They have studied and reproduced here roentgenograms from 6 of the previously reported cases. It is their belief that calcified tuberculomas present a sufficiently typical appearance in the roentgenogram to permit diagnosis.

In the development of a calcified tuberculoma a shell of calcium is deposited about an area of caseation necrosis and is in turn surrounded by a wall of dense hyalinized or collagenous connective tissue. The inner ring of calcium is usually broken to some degree by contraction of the outer connective-tissue zone, and it is this irregularly broken calcareous shell that is considered by the authors to be characteristic of the calcified tuberculoma. Calcified hemorrhage or abscess, however, may produce a similar appearance on the roentgenogram. Since tuberculomas are commonly located in the cortex, the roentgen shadows are, as a rule, seen near the inner table of the skull. The lesions are usually, though not invariably, single.

Clinical symptoms are of long duration, ranging from four to sixty-one years in the cases reported. In most instances there was little evidence of active systemic tuberculosis. Very few patients show signs of increased intracranial pressure.

H. H. WRIGHT, M.D.

Calcification in the Choroid Plexus. F. Jacobsson. *Acta radiol.* 22: 643-650, December 1941.

Calcification in the choroid plexus is frequently observed in the roentgenogram. Beals reports its occurrence in 28 per cent of 86 cases (*Radiology* 15: 268, 1930). In a much larger series Dyke and Davidoff found an incidence of 9.4 per cent for the age group between forty and eighty years. (*Bull Neurol. Inst. New York* 2: 331, 1932). All statistics stress a somewhat higher incidence in men than in women.

While the glomus choroideum is the most typical location, calcification may be encountered in any portion of the plexus of the lateral ventricles and even, though rarely, of the third ventricle. Generally, the calcifications show a fairly symmetrical bilateral distribution but occasionally they may be asymmetrical and occupy different anatomical levels. From this observation it is concluded that extreme caution must be exercised in the evaluation of atypical position or asymmetrical distribution of calcification in the differential diagnosis between a normal brain appearance and pathologic conditions, especially expansive intracranial tumors and unilateral cortical atrophy.

E. A. SCHMIDT, M.D.

A New Method of Pneumography of Subarachnoid Basal Cisterns. J. Frimann-Dahl and B. Ingebrigtsen. *Acta radiol.* 22: 592-597, December 1941.

The authors stress the importance of adequate filling

of the cisterna pontis, cisterna chiasmatis, and cisterna interpeduncularis for the encephalographic diagnosis of tumors in the region of the sella turcica. To obtain a more satisfactory visualization of these spaces than is generally achieved by ordinary encephalography, small amounts of air (10 to 15 c.c.) are injected by the lumbar route and an effort is made to direct the injected air to the cisternal area by special positioning of the patient. By this "cisternography" (as the authors call it) suprasellar and intrasellar tumors can be differentiated; observation of the outlines of the sellar diaphragm is especially valuable for this purpose. Deformity of the cisterna interpeduncularis is seen in intrapontine tumors; clivus tumors displace or deform the cisterna pontis.

E. A. SCHMIDT, M.D.

Roentgenographic Diagnosis of Pathologic Conditions in the Nasopharynx. G. Jönsson. *Acta radiol.* 22: 651-664, December 1941.

Roentgenograms can often be of aid in diagnosing neoplasms of the nasopharynx, the tumor appearing as a soft-tissue shadow bulging into the air-filled lumen. A straight lateral view of the nasopharynx and an axial view of the skull in the submentoparietal projection permit the study of the lumen of the nasopharynx and the condition of the bones at the base of the skull.

A comprehensive film study of 104 cases of nasopharyngeal lesions was made with regard to position, shape, surface contour, and bone erosion. It was concluded from this study that one cannot only tell from the soft-tissue swelling whether a tumor is present, but also, in the majority of cases, whether or not it is malignant. Malignant tumors (carcinoma, sarcoma) have a tendency to be diffuse, with indistinct outlines, and to be asymmetrical situated in the roof and superior part of the posterior wall, while benign lesions (adenoids, tuberculosis, inflammations) are usually situated in the mid-line lower down. Sixty-six of 79 malignant nasopharyngeal neoplasms were correctly diagnosed on this basis. Destruction of the cranial base bordering on the wall of the nasopharynx is additional evidence of malignancy. Carcinoma has a greater tendency to produce destruction than sarcoma.

Of benign conditions, pharyngeal fibroma is generally recognized without difficulty. It has a rounded, well circumscribed outline, with extensions growing down in the nasopharynx and out into the nasal cavities. The fact that it occurs almost exclusively in males at the age of puberty is an aid in diagnosis. Differentiation between adenoids and inflammatory conditions in the adult is impossible, nor can they be distinguished with certainty from malignant tumors, which in exceptional cases may present a similar roentgen picture.

GLENWOOD L. COOK, M.D.

Roentgen Anatomy of the Larynx. C. G. Zachrisson. *Acta radiol.* 22: 859-865, December 1941.

For the x-ray examination of the larynx, it is advisable to make use of definite and uniform vowel phonation in order to avoid inaccurate and inconstant pictures due to suspension of breathing. If certain vowels, e.g., "e" or "i" (in continental pronunciation), are intoned, the examiner can familiarize himself with a

constant appearance, which considerably facilitates clinical interpretation. The author describes the salient points of laryngeal radiography as well as the relations of the larynx to the hypopharynx.

E. A. SCHMIDT, M.D.

THE BREAST

Mammography in Breasts with Pathologic Secretion. N. Frostberg. *Acta radiol.* 23: 9-21, February 1942.

Since February 1939, at the Norrköping Hospital, all patients with pathologic discharge from the nipples have been subjected to mammography. In general, Hicken's method is followed (see *Am. J. Roentgenol.* 39: 321, 1938); thorotrast is used as a contrast medium. Fourteen patients have been examined. In 4 cases, papilloma was diagnosed; in 7 cases, cysts (2 with suspicion of cancer). In 3 cases, mammography was unsuccessful, either due to small, flat nipples or virginal breasts.

E. A. SCHMIDT, M.D.

THE CHEST

Multiple Benign Sarcoid of the Upper Respiratory Tract. D. L. Poe. *Ann. Otol., Rhin. & Laryng.* 51: 430-444, June 1942.

The author was unable to find any references in the literature to involvement of the upper respiratory tract by sarcoid. He reports in detail the case of a colored female, 41 years of age, who showed the typical dermatological sarcoid lesions of the face and body, as well as lesions in the nose, the lips, the hard palate, and larynx. Bronchoscopic examination also revealed tumor-like conglomerations deep in the trachea, close to the bifurcation. Chest roentgenograms showed the presence of lymphomatous masses along the tracheobronchial tract. Roentgenographic studies of the hands and feet showed circumscribed areas of osteoporosis in some of the phalanges, and the mandible contained a large circular area of rarefaction in the horizontal portion of the bone. Tissue taken from the epiglottis, larynx, and subglottis, as well as small pieces from the trachea, were reported as non-caseating tubercles suggesting sarcoid. Histologic examination of skin tissue revealed the same findings. The tuberculin test was negative.

L. W. PAUL M.D.

THE DIGESTIVE TRACT

Diagnosis of Cavernous Hemangiomas in the Digestive Tract. R. Kaijser. *Acta radiol.* 22: 665-686, December 1941.

Hemangiomas of the digestive canal may be histologically classified as (1) multiple phlebeectasias, (2) cavernous hemangiomas, (3) hemangioma simplex, and (4) angiomatosis. Of these types, only cavernous hemangiomas present sufficient roentgenologic phenomena to become accessible to x-ray diagnosis and to permit radiologic differentiation from other benign intestinal tumors. The roentgen signs are either calcifications, of the same nature as phleboliths, or changes in the contour of the gastro-intestinal wall. In diffusely infiltrating cavernous hemangioma, as a rule, narrowing of the intestinal lumen is observed.

In the evaluation of phlebolith shadows, the location is of considerable importance, since the diagnosis is, of

course, considerably more difficult if phleboliths are seen in areas where their extra-intestinal occurrence is frequent, e.g., in the vascular domain of the pelvis. Localization of phleboliths in the mid-line or their extensive presence in young patients may raise the suspicion of hemangioma. Correlation of roentgenological and clinical findings is in most cases indispensable for a correct diagnosis. In some cases, other diagnostic methods (rectoscopy, palpation, exploratory laparotomy) may be helpful in supplementing the x-ray findings and in establishing a more definite diagnosis.

With regard to therapeutic procedures, surgical removal of the tumor is the method of choice wherever it is feasible. For inoperable cases, injection of a sclerosing solution into the tumor may be considered, but the dangers of such treatment (especially necrosis and ulceration) must not be overlooked.

E. A. SCHMIDT, M.D.

Roentgen Findings in Congenital Atresia of the Esophagus. E. Selander. *Acta radiol.* 22: 802-807, December 1941.

The author describes two cases of congenital atresia of the esophagus in which roentgenograms revealed the condition without the aid of a contrast medium. The diagnosis was made possible by the presence of air in the esophageal stump as well as by displacement and narrowing of the adjacent portion of the trachea.

E. A. SCHMIDT, M.D.

Treatment of Impenetrable Esophageal Strictures by a Combined Intraesophageal and Extraesophageal Approach. E. C. Drash and F. D. Woodward. *Surgery* 11: 886-897, June 1942.

Esophageal obstruction is a rather frequent occurrence. Most of the obstructions are due to cicatricial stenosis resulting from the ingestion of strong alkalis or acids, carcinoma of the esophagus, diverticula, or cardiospasm. Complete fusion of the esophageal walls resulting from extensive burns is quite uncommon, but multiple areas of stricture are frequently seen. While there may be complete blocking of the esophagus at one point, usually the remainder escapes such severe injury and can be dilated by the usual means. Methods have been suggested for opening an esophageal obstruction and attempts have been made to construct an artificial esophagus. Most of these latter attempts have resulted in such poor substitutes that it seems advisable to restore the esophagus to its normal function whenever possible. This contribution presents a new means of accomplishing this end in cases not amenable to simple methods.

The procedure, in brief, consists in guiding bougies through the area of stricture by external manipulation effected through surgical exposure of the constricted area, but without opening the esophagus. The bougies are passed either from above or below, or both.

Three case reports are given. The first patient had a lye burn of the cervical esophagus with a stricture through which it was impossible to pass a bougie either from below upward or from above downward. The esophagus was exposed surgically from the right side. After several unsuccessful attempts the surgeon grasped the lower bougie, which was palpated through the esophagus and brought it firmly against the stricture. The fold of mucosa acting as a diaphragm was then incised

from above through an esophagoscope and the bougie was successfully passed.

The second patient was a 72-year-old woman who had been having increasing difficulty in swallowing for two years. At the time of admission she was able to swallow only liquids. X-ray examinations showed failure of barium to enter the upper end of the esophagus. It was felt that a tumor might be present but esophagoscopy was unsatisfactory, as the esophagoscope could not be introduced into the esophagus, apparently having run into a blind pouch. External exploration showed no evidence of a diverticulum or any other abnormality. The esophagoscope was then introduced and guided by making traction on the edges of the incision. It was passed easily into the lower esophagus. A tube was inserted into the stomach and the esophagoscope was removed. The patient did well thereafter. The clinical diagnosis was spasm of the cricopharyngeal muscle.

The third case was one of multiple lye burns of the esophagus including the upper and lower thirds. A gastrostomy was done and complete occlusion was shown by x-ray examination. Attempts to permeate the occlusion under biplane fluoroscopy in another clinic were unsatisfactory, and for two years the patient lived a "gastrostomy life." Re-examination at the end of that time showed the esophageal obstruction to be still complete. The abdominal cavity was opened and a bougie introduced in the stomach with the tip in the lower end of the esophagus. It was not found possible to force it any further. Later another attempt was made to pass a bougie from above downward, following surgical exposure of the cervical esophagus; this was unsatisfactory also and the attempt was discontinued.

The authors conclude that external exposure of the esophagus is a safe surgical procedure to aid in the passage of bougies for the permeation of complete esophageal strictures, in selected cases, when other methods have failed.

J. E. WHITELEATHER, M.D.

On Perforated Gastro-duodenal Ulcers: Roentgen Examination and Clinic. T. Klason. *Acta radiol.* 22: 687-693, December 1941.

The author reports a series of 97 cases of perforated peptic ulcer (42 gastric and 55 duodenal) in 90 per cent of which free peritoneal air could be demonstrated by roentgen studies. It was found that in the majority of the cases, the perforations occurred while digestion was going on, i.e., about two or three hours after a meal. The peaks of occurrence were in the midmorning, mid-afternoon, and at midnight.

GLENWOOD L. COOK, M.D.

The Meniscus-Complex in the Roentgenologic Diagnosis of Ulcerating Carcinoma of the Stomach. B. R. Kirklín. *Am. J. Roentgenol.* 47: 571-577, April 1942.

In 1921 Carman (*J. A. M. A.* 77: 990, 1921) described the meniscus sign, which he considered pathognomonic of ulcerating carcinoma of the stomach. Since then the sign has been widely used by roentgenologists, but in some instances, undue emphasis on the less important features described by Carman and omission of the essential criteria have led to incorrect diagnosis of ulcerating gastric carcinoma. The author points out that the really significant features are the elevated border of the ulcerous cavity and the fact that the crater does not extend into the gastric wall but is based on the inner aspect of the wall. This intraluminal rather than intra-

mural situation of the ulcer crater has not always been sufficiently emphasized.

Two conditions which may simulate the meniscus-complex are the retention of barium between two hypertrophic rugal folds near the lesser curvature and peptic ulcer of the posterior wall of the stomach. These can usually be differentiated without too much difficulty. When clearly understood, the meniscus-complex affords a highly reliable means of identifying ulcerating gastric carcinoma.

H. H. WRIGHT, M.D.

Terminal Ileitis and Its Roentgen Picture. J. P. Strömbeck. *Acta radiol.* 22: 827-833, December 1941.

The ileocecal region is the seat of many acute and chronic inflammatory disorders other than appendicitis. This is due in part to the abundant lymphatic tissue collected in Peyer's patches and in the mesentery in the ileocecal angle.

Acute terminal ileitis, not infrequently found in acute infections (influenza, bronchitis, measles), can be diagnosed roentgenologically by alterations in the mucous membrane relief in the lower ileum. The membrane appears elevated and irregular due to the edema present. The mucosal swelling is most pronounced next to the ileocecal valve. In a case illustrated there was a filling defect at the site of the valve and on fluoroscopy a tender mass could be felt corresponding to the defect. The diagnosis is all the more certain if the appendix fills normally.

Chronic terminal ileitis is characterized pathologically by thickening of the wall with constriction of the lumen, ulceration, and at times fistula formation. Roentgenologically, the striking feature of this condition is the "string sign," a thin linear shadow extending from the last visualized loop through the filling defect to the ileocecal valve. This picture oftentimes cannot be differentiated from that of ileocecal tuberculosis.

GLENWOOD L. COOK, M.D.

Roentgen Findings in Intestinal Knots. J. Frimann-Dahl. *Acta radiol.* 23: 22-33, February 1942.

The roentgenographic findings in two verified cases of ileus due to knot formation between the ileum and sigmoid are reviewed. The picture, which was similar in the two cases, is assumed to be characteristic of this type of bowel obstruction. An enormously distended, displaced loop of sigmoid appeared in the right upper quadrant and extended downward to the right iliac fossa, where it terminated in a small, pointed, cone-shaped process. The remainder of the large intestine was quite deflated. In the upper left quadrant were several loops of small intestine, presumed to be ileum. The barium enema filled the rectum and stopped abruptly at a point corresponding to the middle of the sigmoid.

With this characteristic picture and with the aid of the clinical symptoms, the author believes that a differential diagnosis may be made between ileus caused by volvulus and ileus caused by knot formation. With the former, there is no displacement of the sigmoid to the upper right quadrant, nor is the large intestine so completely deflated.

GLENWOOD L. COOK, M.D.

Intermittent Volvulus of the Mobile Cecum. F. J. Ingelfinger. *Arch. Surg.* 45: 156-163, July 1942.

Partial volvulus of a mobile cecocolon is a rarely suspected cause of right lower quadrant pain. A mobile

right colon represents an anomaly of fixation; a persistence of the embryonic mesentery of the cecum to greater or less degree. Little correlation can be shown between cecal mobility and clinical symptoms; some degree of mobility is common but sufficient to permit spontaneous volvulus in the intact abdomen is rare. The presence of a suitable fixed point about which the bowel can rotate is also necessary to permit volvulus.

A case is reported in which this abnormality was diagnosed preoperatively. Gastro-intestinal studies were inconclusive, but after a Miller-Abbott tube was inserted and allowed to enter the cecum, it was discovered that the cecum had rotated medially and through 180°. Spontaneous reduction occurred during the fluoroscopy. At operation the diagnosis was confirmed and a cecopexy was done, with subsequent relief of symptoms. The use of Miller-Abbott intubation in conjunction with fluoroscopic study, both with and without barium, is considered essential to successful diagnosis.

LEWIS G. JACOBS, M.D.

THE PANCREAS

Value of Roentgen Examination of the Pancreas.

O. F. Holm. *Acta radiol.* 22: 620-641, December 1941.

Holm analyzes the results of 449 x-ray examinations of the pancreas in two Stockholm hospitals. In 77.8 per cent of the cases the roentgen findings (enlargement or diminution of the pancreatic shadow, pancreatic calculi or calcifications, changes in the duodenum and other neighboring organs) pointed to pathologic involvement of the pancreas. Of the cases of cancer of the pancreas, 86 per cent gave positive roentgen findings. A method is described by which the "seat" ("loge") of the pancreas may be visualized and diagnostically evaluated.

Changes in the size of the organ (enlargement or shrinking) are observed in numerous affections of the pancreas proper. On the other hand, decrease in size may be simply concomitant with heavy loss of body weight, while enlargement frequently coexists with non-pancreatic diseases (ascites, liver tumors, hypernephroma, retroperitoneal tumors, intra-abdominal tumor metastases, ulcer infiltrates, and general obesity).

E. A. SCHMIDT, M.D.

THE BILIARY TRACT

On Cholangiography. O. O. Schuberth and S. E. Sjörén. *Acta radiol.* 22: 780-795, December 1941.

Primary cholangiography performed at the time of operation in 76 cases of suspected biliary duct disease proved to be of invaluable aid from a diagnostic standpoint. The technic consisted in insertion of a cannula into the cystic duct and injection of 6 to 8 c.c. of perabrodil, after which the first picture was taken. A second exposure was made following another injection of perabrodil, and while the films were being developed cholecystectomy was performed. On the basis of the roentgen and operative findings it could be determined whether or not a choledochotomy should be done. In interpreting the films, three roentgenological findings were used: (1) filling defects, (2) dilatation of the common duct, and (3) obstruction of passage of the medium to the duodenum.

The greatest clinical value of the cholangiogram was the accuracy with which stones could be diagnosed as to

number, size, and locality. In not a single instance were stones found that could not be demonstrated on the cholangiogram.

The average width of the common duct in the 27 cases of choledocholithiasis was 15 mm. and in only 3 cases was the width less than 11 mm. (The average width of a normal common duct is 7-11 mm.)

The most common cause of obstruction of the common duct was purely mechanical (stones), but it was conceived that the presence of stones in the biliary system may produce enough irritation to cause a reflex spasm of the sphincter of Oddi and thus obstruct the passage in this way. Several cases in which no stones could be demonstrated showed obstruction on the cholangiogram after instrumental exploration of the common duct.

GLENWOOD L. COOK, M.D.

On Hepatosplenography with "Jodsol." O. Olsson. *Acta radiol.* 22: 749-761, December 1941.

The intravenous injection of "jodsol" (ethyl ester of triiodide-stearic acid) was tried in 9 cases of suspected liver pathology as a means of demonstrating the liver and spleen. The minimum quantity of iodine required to produce the best contrast, as determined by Beckermann (Hepatolienographie mit Jodsol, Leipzig, Georg Thieme, 1940) is 250-300 mg. per kg. of body weight, which amount is contained in 1.4 c.c. of the medium. Animal experimentation showed that about half of the iodine finds its way to the liver and one-tenth to the spleen, and that it is completely excreted in about three days by the kidneys as sodium and potassium iodide.

The roentgenograms obtained by this method showed the liver and spleen as faint, homogeneous, opaque shadows. Areas of rarefaction were interpreted as showing tumor involvement.

Considerable attention was given to the secondary ill effects that followed injection of the opaque medium, which, in the author's opinion, prevent the adoption of this method as routine. One patient, with cardiac insufficiency, died in direct connection with the examination. Another became almost moribund, with falling blood pressure, bewilderment, tremor, and rising non-protein nitrogen, but recovered several days later. Three others showed slight reactions of iodine poisoning, while the remaining four were symptom-free. It is stressed that precautions should be taken against overdosage, since destruction of the liver parenchyma by existing disease substantially reduces the available storage space for the iodine. The secondary ill effects can probably be explained on this basis. The suggestion is made that pictures be taken during the progress of the injection, which should proceed very slowly—2 to 3 c.c. per minute of the 75 to 100 c.c. dose of the opaque medium. It is thus sometimes possible to obtain a satisfactory picture before the full dose has been injected.

GLENWOOD L. COOK, M.D.

THE SKELETAL SYSTEM

Pathology of Tuberculosis of the Spine. M. Cleveland and D. M. Bosworth. *J. Bone & Joint Surg.* 24: 527-546, July 1942.

The authors have investigated material to determine the location, type, and method of invasion of tuberculosis of the adult human spine. The teaching is prevalent that the disease begins in the intervertebral disc but this could not be confirmed by autopsy studies

[confusion between radiologic and pathologic diagnosis—J. B. M.]

In a study of numerous tuberculous human spines two constant gross pathological states were found in the bone: caseation and sclerosis. Caseation is found in bone, soft tissue, and perichondrium; never in the intervertebral disc until massive destruction has occurred. The disc is then usually seen as a coagulated slough, not as a caseous mass.

Sclerosis of the vertebral body is of frequent occurrence. It is believed to be due to loss of blood supply to a portion of bone. In support of this view the author cites several observations. (1) Sclerosis of the vertebral body is seen grossly with a typical pattern of infarction extending away from an area where the blood supply has been removed. (2) It is not seen unless there has been a massive dissecting abscess stripping the soft tissues and blood supply from the bone or an obliterating vascular process. (3) The microscopic picture shows little or no evidence of regenerative bone change. (4) Microscopically, also, coagulative areas of necrosis due to ischemia are seen.

In the sclerotic lesions progress is usually slow, but in the lytic lesions, where the blood supply is good, progress is rapid, with destruction and deformity.

Roentgenography has definite limitations. Tuberculous spondylitis may be present in an advanced state without showing evidence on the film. Certain roentgenographic findings have formerly been overlooked, but are now recognized and defined, leading to an earlier diagnosis of this condition. The characteristic finding is a sclerosis or mottling of the vertebral bodies in a known tuberculous patient.

Several specimens are shown with roentgenograms taken before death and after removal of the involved bone postmortem. Here the areas of sclerosis are demonstrated and the changes on the films identified as those due to tuberculosis. In some of the reproductions the lesions would seem rather difficult to identify as tuberculosis in the living subject.

JOHN B. McANENY, M.D.

Legg-Perthes Disease: A Comparative Study of Various Methods of Treatment. L. J. Levy and P. M. Girard. *J. Bone & Joint Surg.* 24: 663-671, July 1942.

In order to evaluate the various methods of treating Legg-Perthes disease, 102 cases were studied, 11 of which were bilateral, bringing the total of diseased hips to 113. For purposes of evaluation the roentgen findings were considered of greater significance than the clinical observations, the most essential criterion being the amount of flattening of the femoral head. In determining this factor, however, the regularity and shape of the head must be taken into consideration.

The cases are grouped according to treatment and the results are classified as excellent, good, fair, and poor according to a scheme which takes into consideration the height of the femoral head, the range of motion, the amount of shortening of the leg, and the absence or presence of pain.

Sixteen patients received no treatment. In this group there were no patients who could be considered as obtaining an excellent result. Results were good in 19 per cent and fair in 25 per cent, but poor in 56 per cent.

Twenty-one patients were treated with a Thomas-ring type of brace. The results were excellent in 9.5 per cent; good in 9.5 per cent; fair in 48 per cent; poor in

33 per cent. The average degenerative period lasted sixteen months and the regenerative period was seventeen months.

Treatment with brace and elevation of the opposite shoe gave results similar to those obtained with brace only. In no patient was an excellent result obtained. Forty per cent had a good result; 20 per cent fair; 40 per cent poor. The degenerative period lasted twenty-one months and the regenerative period about twenty months.

When the patient was treated first with a spica cast for four months, then with brace and elevation of the opposite shoe, results were somewhat better. Excellent results were obtained in 25 per cent; good results in 50 per cent; fair in 25 per cent. The degenerative phase lasted eighteen months and the regenerative phase nineteen and a half months.

Eight patients were subjected to drilling of the femoral neck, with application of a cast, brace, and elevation of the opposite shoe. Results in this group were excellent in 12.5 per cent; good in 62.5 per cent; fair in 12.5 per cent; poor in 12.5 per cent. Degeneration continued for sixteen months and regeneration required fifteen months.

Patients treated for eight months with a cast and later with crutches and gradual weight-bearing showed no excellent results; 11 per cent had a good result; 22 per cent had a fair result; 67 per cent a poor result. Degeneration lasted nineteen months and regeneration twenty-one months.

Patients kept in a cast for four months and then in a brace showed excellent results in 15.5 per cent; good in 23 per cent; fair in 38.5 per cent; poor in 23 per cent. Degeneration and regeneration each required sixteen and a half months.

When the opposite shoe was elevated and crutches were used, the results were excellent in 13.3 per cent; good in 53.4 per cent; fair in 20 per cent; poor in 13.3 per cent. Degeneration and regeneration each required sixteen months.

The patients in this series were between the ages of three and thirteen years; 91 per cent were males and 9 per cent females. The average course in well treated cases is about two and a half years. The transition between degeneration and regeneration is fairly abrupt and each phase lasts about sixteen months.

The simplest, most effective, and most economic method of treatment was elevation of the uninvolved leg and the use of crutches. There must be no weight-bearing on the diseased extremity. In the presence of muscle spasm or restricted motion, preliminary traction in bed is advised. With involvement of both hips, bed rest is necessary from the beginning.

JOHN B. McANENY, M.D.

Cystic Tuberculosis of the Long Bones. A. Clausen *Acta radiol.* 23: 99-107, February 1942.

Two cases of cystic tuberculosis are described. The first case was seen in a 31-year-old woman. The lesion originated in the upper portion of the tibia and extended into the knee-joint. In the differential diagnosis, osteitis fibrosa cystica and benign giant-cell tumor had to be excluded. Arthrography helped to establish the correct diagnosis.

In the second patient, a 5-year-old boy, the distal portion of the left radius was involved. The final diagnosis of tuberculosis was established by biopsy. It is emphasized that in many cases of bone tuberculosis only

one bone is affected by the disease and that frequently the differential diagnosis may be very difficult.

E. A. SCHMIDT, M.D.

Neurogenic Sarcoma. I. H. Maseritz. *J. Bone & Joint Surg.* 24: 586-595, July 1942.

The neurogenic sarcoma is a malignant variety of fibrosarcoma arising from the supporting tissue of nerves. This report of 216 cases of solitary primary neurogenic sarcomas shows them to occur more frequently in the extremities. It is believed that they arise from the nerve sheath.

Grossly the tumor appears gray, firm, and infiltrating. It resembles a fibrosarcoma of fascial or periosteal origin. Cystic degeneration may occur. Microscopically the early appearance is mesenchymal. The cells are round or oval, with little cytoplasm, irregular in size and often multinucleated. With further growth some cells become spindle-shaped.

In the series reported, treatment consisted usually in excision. If the deep tissues are involved, amputation is advised. Irradiation in the cases recorded was of little value.

Of 216 patients, 115 were traced: 38 were living, 18 less than five years, 10 from five to ten years, 8 from ten to twenty years, and 2 over twenty years.

The author reviews, also, a series of 36 cases of von Recklinghausen's disease. Of these, 4 (11 per cent) became malignant.

Six instances of primary neurogenic sarcoma of the soft parts invading osseous structures were encountered. In 2 instances neurogenic sarcoma arose from the periosteum and invaded both osseous and soft tissues. Four cases consisted of primary central neurogenic sarcoma of bone. It is believed that the exact origin of these tumors is from the nerves of the blood vessels. The roentgenographic changes resembled those of osteoclastic bone tumors and biopsy was required for diagnosis.

JOHN B. McANENY, M.D.

Neurilemmoma of Bone. A Case Report. A. H. Conley and D. S. Miller. *J. Bone & Joint Surg.* 24: 684-689, July 1942.

This report concerns a married woman of thirty-two years complaining of pain along the distribution of the left sciatic nerve and numbness and coldness of the entire left extremity, beginning eleven years previously. Roentgenograms showed a bone lesion on the left of the first sacral segment, of cystic appearance. This lesion was incised and curetted, thick, grayish-yellow, friable material being removed. The space was filled with blood but no bone chips. Roentgen therapy of unstated amount and quality was given weekly for ten weeks. The patient is living and well three years after operation.

JOHN B. McANENY, M.D.

Eosinophilic or Solitary Granuloma of Bone. W. T. Green and S. Farber. *J. Bone & Joint Surg.* 24: 499-526, July 1942.

This is a study of 10 children with single or multiple lesions of bone identical with those described in the recent literature as "solitary granuloma" or "eosinophilic granuloma." This condition is believed not to be a new disease, but a variant of the basic process manifested in Hand-Schüller-Christian disease, xanthoma, and Letterer-Siwe disease.

Five typical cases are reported with care and great detail and accompanied by numerous roentgenograms and photomicrographs.

Clinically the general manifestations are of little or no significance. The ages in this group ranged from eleven months to ten years and eleven months; 9 of the patients were males. Four patients had single lesions; 6 had several lesions, averaging 16, with a maximum of 25.

The individual lesion was round, oval, or irregular, punched-out in appearance, without cortical expansion but with occasional erosion. A lesion may develop or heal rapidly. Multiple lesions have the distribution of metastatic neoplasms or multiple myeloma. Flat and irregular bones are more commonly involved, and of the bones of the extremities only those near the trunk are affected.

Swelling is often noticed but pain is not necessarily present. Fever was not present. No mental or nervous manifestations were evident. Trauma is eliminated as a cause. Leukocytosis is sometimes seen and eosinophilia rarely. Blood chemistry is not abnormal.

Pathologically the destructive lesion is essentially a granuloma. Early there is bone destruction with infiltration of many eosinophils or large mononuclear cells. Plasma cells, lymphocytes, and leukocytes are also seen. The monocytes are actively phagocytic and are at times frankly "foamy" in character. In later stages the eosinophils are absent, the monocyte predominates, and fibrosis occurs. Still later the monocytes become vacuolated, giving the appearance of "foam" cells; connective tissue formation and ossification follow.

The best therapeutic response is obtained from irradiation. The exact technic is somewhat indefinite, one case receiving 250 r daily through two different fields for six days for a total of 1,500 r. The factors were 160 kv., 5 ma., 40 cm., and 0.25 mm. Cu plus 1.0 mm. Al filtration. Twelve treatments were the maximum given to any single lesion. The lesions healed in an average of one year and seven months after admission.

In the solitary form the condition must be differentiated from osteomyelitis, tuberculosis, syphilis, solitary bone cyst, and giant-cell tumor. Multiple lesions must be distinguished from multiple myeloma, metastatic neuroblastoma or lymphoma, and generalized osteitis fibrosa cystica.

JOHN B. McANENY, M.D.

Experiences with Epidural Contrast Investigation of the Lumbosacral Canal in Disc Prolapse (Perabrodil). F. Knutsson. *Acta radiol.* 22: 694-703, December 1941.

The injection of a radiopaque solution into the epidural space to demonstrate intraspinal disc protrusion was tried in about 20 cases. The technic employed was essentially the same as that used for sacral anesthesia. A needle was introduced through the sacral hiatus into the sacral canal, care being taken not to enter the dural sac. For anesthesia 10 c.c. of 1 per cent novocain was used. Twenty cubic centimeters of 35 per cent perabrodil were then rapidly injected and films were taken in the lateral, oblique, and anterior-posterior positions.

The lateral view showed two contrast layers: (1) a ventral layer, less than 0.5 cm. thick, lying between the dural sac and the posterior aspect of the vertebral bodies; (2) a dorsal layer, about 0.5 cm. thick, between the dural sac and the vertebral arches.

It was found that small prolapses, the size of a pea or bean, were not large enough to cause a filling defect of the ventral layer. Only in cases of protrusions comprising the greater part of the cross-section was the diagnosis reliable. Thus, a negative result would not entitle one to exclude the possibility of smaller prolapses. In cases of adhesions between the dura and walls of the spinal canal (pachymeningitis) or tumor in a vertebra with obliteration of the epidural space, the method would seem to have great possibilities.

GLENWOOD L. COOK, M.D.

On Movements of Fluid Inside the Cerebrospinal Space. H. Reitan. *Acta radiol.* 22: 762-779, December 1941.

Quite by accident during a fluoroscopic examination for prolapsed disc, movements of the iodipine column were observed during different phases of respiration. At inspiration, the column appeared to rise and became longer and narrower, while at expiration it fell and became shorter and thicker. This observation led to an investigation on 17 patients, in which similar results were obtained.

Roentgenograms of the sacral region taken in the prone position confirmed the fluoroscopic findings. Similarly, when the Valsalva test was done to increase abdominal pressure, the iodipine column rose, as at inspiration. Results obtained with the patient in the standing position were conclusive, but less marked. The average rise of the column during the examinations was 1-4 cm. When the Queckenstedt test, with compression of the jugular veins, was carried out, the column fell and became thicker, as at expiration.

The movement of the cerebrospinal fluid in these examinations is thought to be due to circulatory changes. An increase in abdominal pressure retards venous return and thereby causes a swelling or dilatation of the internal venous plexus situated around the dural sac in the epidural space. The stasis in the venous plexus thus produces a concentric narrowing of the dural sac and an upward movement of the spinal fluid into the cranium. During the Queckenstedt test there is an increase in amount of blood in the cranium, thus causing a corresponding amount of cerebrospinal fluid to be pressed down into the dural sac.

It was shown that the narrowing of the dural sac might occasion the disappearance of the filling defects due to disc prolapses, the existence of which was verified later at operation.

GLENWOOD L. COOK, M.D.

Fractures and Fracture-Dislocations of the Astragalus (Talus). R. D. Schrock, H. F. Johnson, and C. H. Waters, Jr. *J. Bone & Joint Surg.* 24: 560-573, July 1942.

More study and better correlation are necessary in order to prevent serious dysfunction secondary to injuries of the astragalus. Much of the work on these injuries has been done on single cases. Few series of any extent have been recorded.

The blood supply of the astragalus is poor. It is derived from branches of the anterior tibial artery which perforates the superior astragaloscaphoid ligament and supplies the superomedial aspect of the astragalus neck. With this poor blood supply, it is not surprising that aseptic necrosis frequently follows injuries to this bone.

In treating fracture-dislocations of the astragalus the

advice of Miller and Baker (*South. M. J.* 32: 125, 1939) is followed. Simple fractures should receive simple treatment. In fractures with displacement or derangement of the articular surfaces, early open replacement must be done or a subastragalar arthrodesis effected. If painful joints occur following reduction, arthrodesis is indicated. Astragalectomy is done only in the presence of frank infection.

Traumatic arthritis of the tibio-astragalar joint frequently follows these injuries, probably due to impacted fracture or infraction of the subchondral surface of the tibia and the dome of the astragalus at the time of the initial injury.

The authors' report covers a series of 30 patients with 32 lesions. Six of the cases are presented in detail with reproduction of instructive radiographs.

JOHN B. McANENY, M.D.

OBSTETRICS AND GYNECOLOGY

Roentgenography of the Obstetric Pelvis: Combined Isometric and Stereoscopic Technic. K. B. Steele and C. T. Javert. *Am. J. Obst. & Gynec.* 43: 600-610, April 1942.

In the study of 4 dried pelvises the authors used the isometric scales principle in lateral and frontal films and the parallax principle of the stereoscope, with an average error of 0.5 mm. or less. Concise instructions for utilization of these methods are presented. The scales used are prepared by exposing a set of centimeter scales at levels 1 to 14 cm. above the x-ray table and the proper scale for measurement is determined directly from the lateral film. Radiographic technic, the positioning of the patient, and the technical factors used are described in detail.

Lines are drawn on the lateral film and anteroposterior diameters are measured directly on the isometric scale. The anterior transverse diameter of the superior strait, obtained by a line drawn between the iliopectineal eminences, provides the key to the type of the forepelvis. Models of the inlet are utilized, based on the four parent pelvic types of Caldwell and Moloy, anthropoid, gynecoid, android, and platypeloid. The models demonstrate the character of mixed types in relation to variations of the anterior transverse diameters.

Cephalometry can be carried out but may in some cases lead to erroneous deductions. Estimation of the weight of the infant from diameters of the head is not practised routinely.

PAUL R. WEEKS, M.D.

X-Ray Localization of the Placenta. B. H. Buxton, R. R. Hunt, and C. Potter. *Am. J. Obst. & Gynec.* 43: 610-619, April 1942.

Roentgenographic methods for localization of the placenta during the last trimester of pregnancy have been used in the last ten years in cases of painless bleeding in an attempt to avoid sudden massive hemorrhages as a result of manual examinations.

The authors report their experience with 126 cases. Two separate radiographic procedures are described. The first utilizes the soft-tissue technic, with right and left lateral films of the entire uterus. Low voltage and relatively high speed are essential. The factors are: 60 ma.; target-film distance 36 inches; kv.p. between 65 and 70 and time between three and four seconds, depending upon the obesity of the patient. Ultra-speed

film is used with a high-speed double intensifying screen and a Potter-Bucky diaphragm. The films are developed by sight, without accurate time or temperature control, but the illustrations used indicate that they have been well processed. In some instances a concentrated source of light is used for viewing the films. Facility in interpretation is acquired only after study and experience.

By this method the placenta is visualized as a fusiform thickening on the wall of the uterus, reaching an average thickness of 7 cm. at its mid-portion. The authors localized the placenta in 86.1 per cent of 108 cases where this method was used. In 74 it was fundal and in 19 was wholly or in part in the lower uterine segment. In 9 cases no placenta was seen, and in 4 cases there was uncertainty about the significance of the shadows.

The 9 cases where no placenta was demonstrable by the above method were studied by a second method of examination and placenta previa was found in 7. In most instances where placenta previa was suspected further x-ray study with the second method was utilized. In this method, an anteroposterior film of the pelvis is taken by precision stereoscopic technic with 4 per cent sodium iodide in the bladder. A modified soft tissue technic is employed. Normally the space between the presenting part and the filled bladder is 1 to 2 cm. in thickness, while in central placenta previa the placental mass may increase the distance to 5 or 6 cm. With marginal or partial previas, there is unilateral widening anteriorly, posteriorly, or laterally. The authors use from 125 c.c. to 200 c.c. of sodium iodide. The fetal skull can be seen through a 4 per cent solution. At times the placenta itself is seen in stereoscopic study. When a placenta previa is definitely diagnosed roentgenologically, no vaginal examination is made.

The authors state: "By co-ordinating these two methods we have been able to localize the placenta in 97.6 per cent of our cases." They feel that increased security is gained by the roentgen examinations, leading to earlier and safer treatment.

PAUL R. WEEKS, M.D.

X-Ray Demonstration of the Cellular System in the Temporal Bone of the Fetus. S. Welin. *Acta radiol.* 22: 853-858, December 1941.

Welin examined about 600 roentgenograms of pregnant women with special reference to the cell development of the fetal mastoids. In about one-sixth of the cases the roentgenograms allowed conclusions as to this point. Cell development in the mastoid process could be demonstrated in about 4 per cent of the cases; the earliest cell development was seen in an eight-month fetus.

E. A. SCHMIDT, M.D.

Significance of Psammoma Calcification in the Roentgen Diagnosis of Papillary Tumors of the Ovary. J. R. Lingley. *Am. J. Roentgenol.* 47: 563-570, April 1942.

Calcification in the ovary has frequently been demonstrated roentgenographically in cases of dermoid cyst. It has been discovered on pathologic examination in fibromata, sclerosis of the ovary, ovarian cyst, corpus albicans, complete ossification of the ovary, papillary cystadenoma, and papillary cystadenocarcinoma. The occurrence of psammoma calcification (psammoma bodies) in the abdomen is practically limited to the last two conditions named.

Five cases of papillary tumors of the ovary are presented by the author, in all of which psammoma calcification was demonstrable roentgenographically. In 4 of the cases the calcification was extensive. In the fifth only small areas of calcification were seen but, because of their type, the diagnosis of probable papillary tumor of the ovary was made. At operation an early malignant papillary cystadenoma was found.

Where the calcification is minimal in extent, other causes of calcification must be considered in differential diagnosis, such as urinary calculi, pancreatic calculi, calcified mesenteric nodes, and calcified uterine fibroids. The roentgen shadow most closely simulating psammoma calcification is the fine coating of barium frequently observed adhering to the mucosa of the colon several days after gastro-intestinal examination.

The calcification in papillary tumors of the ovary may be quite dense in some parts, but other areas will show the diffuse, hazy type of calcification characteristic of psammoma bodies. It is this type of calcification only that is diagnostic of papillary tumors of the ovary.

H. H. WRIGHT, M.D.

GENITO-URINARY TRACT

Contribution to the Problem of Pyelovenous Reflux. H. Cederlund. *Acta radiol.* 23: 34-43, February 1942.

Cederlund describes 2 cases—one of cystopyelitis and one of malignant papilloma of the renal pelvis—in which, sometime after retrograde pyelography of one kidney, contrast medium was present in the other kidney, apparently due to secretion following pyelovenous reflux. The pressure conditions necessary to produce this phenomenon are discussed, and the dangers of transmitting infectious material from the kidney into the circulatory system by retrograde pyelography are emphasized.

E. A. SCHMIDT, M.D.

The Interureteral Fold in the Roentgenogram. N. P. G. Edling. *Acta radiol.* 22: 573-580, December 1941.

Edling describes the roentgenologic appearance of the interureteral fold which, according to anatomists, is formed by the (median) ligamentum interuretericum and the (lateral) plica ureterica. This fold represents the border between the trigonum vesicae and the fossa retroureterica.

Roentgenographically it is possible to demonstrate the upper contours of the interureteral fold either directly by cystography or indirectly by urography. This visualization may be of clinical importance in the diagnosis of vesical tumors or concretions in the distal portion of the ureter.

E. A. SCHMIDT, M.D.

TECHNIC

Comparison Relative to the Recognition of Detail in Fluorography, Fluoroscopy, and Ordinary Radiography. O. Axén. *Acta radiol.* 22: 547-555, December 1941.

A comparison of detail visualization, especially with regard to small objects of slight density, showed fluoroscopy inferior to both radiography and fluorography. There was little difference in the contrast recording between roentgenograms and fluorograms, but the sharpness of outlines was somewhat poorer in the fluorograms. The author is of the opinion, however, that the results of the fluorographic method may be further improved by technical innovations.

E. A. SCHMIDT, M.D.

RADIOTHERAPY

MALIGNANT TUMORS

Dosage in r-Units in Superficial Radium Treatment of Skin Cancer. M. Strandqvist. *Acta radiol.* 22: 808-826, December 1941.

In order to standardize technic and dosage in radium therapy, the author utilizes a system of uniform applicators (glass capsules of standard sizes) which contain radium needles and are always applied at exactly the same distance not only from one another but also from the surface of the skin (4.5 mm.). This system is based on mathematical calculations and allows a very accurate determination of the intensity of gamma radiation. The salient factor in the dosage system is not the surface reading but the maximal intensity at a tissue depth of 3 mm.

According to the author, a single dose of 2,200 r at a depth of 3 mm. is required for the cure of a superficial basal-cell carcinoma of the skin if Sievert's unit for gamma radiation, the Imc, is considered equivalent to 7.5 r/hour. The Imc (intensity-millicurie) is defined as the thousandth part of the intensity, at 1 centimeter distance, of the gamma radiation of 1 milligram of punctiform radium, filtered by 0.5 mm. platinum. However, Sievert's correlation of Imc to 7.5 r/hour must be considered rather arbitrary, since other physicists obtained entirely different values. According to Glasser, Mayneord, Quimby, and White the ratio is 1 Imc = 8-8.9 r/hour, while clinicians (Braun, Henshaw, Holthusen, Neef) experimentally deduced the average ratio as 1 Imc = 5.4 r/hour. A report of 24 cases treated after this system illustrates the author's method and results.

E. A. SCHMIDT, M.D.

Results of Radiation Treatment of Endolaryngeal Cancer at the Stockholm Radiumhemmet from 1930 to 1939. H. E. Ahlbom. *Acta radiol.* 22: 539-546, December 1941.

During the ten-year period 1930-39, 74 cases of laryngeal carcinoma were treated at the Stockholm Radiumhemmet. The cases are divided into four groups according to the modified Soerensen-Frenckner classification: *Groups 1 and 2*, with involvement of the vocal cords only; *Group 3*, with more or less extensive unilateral involvement of the larynx; *Group 4*, with unilateral or bilateral endolaryngeal involvement and, frequently though not necessarily, extension to the regional lymph nodes.

The treatment consisted either in surgery plus irradiation or in irradiation alone. For radiotherapy both x-rays and telerialium therapy were generally employed. As a rule, the aim was to deliver a tumor dose of 6,000 r within twelve to fourteen days; in postoperative laryngectomy cases this dosage was reduced by about 25 per cent. Postoperatively, only telerialium therapy was used.

The results were excellent in carcinoma of the vocal cords, i.e., groups 1 and 2. All patients of these groups (a total of 13), treated either surgically and radiotherapeutically (5) or radiotherapeutically alone (8), were free of symptoms, metastases, or recurrence at the time of publication, i.e., one to ten years afterward.

Of the 65 cases of groups 3 and 4, 38 were first treated by laryngectomy. The operative mortality amounted

to about 10 per cent but has receded lately. In these cases (laryngectomy and telerialium therapy), about two-thirds of those treated were free of symptoms five years later. In 27 cases, only radiotherapy was employed; 20 of these cases were definitely inoperable. Only 2 of the 27 patients were free of symptoms after a five-year observation period, while 7 remained free of symptoms for one year and 3 for three years. The importance of close co-operation between otolaryngologist and radiotherapist is stressed.

E. A. SCHMIDT, M.D.

Persistence of Tumor after Preoperative Radium Treatment for Cancer of the Corpus Uteri. M. S. Donovan and S. Warren. *Surg., Gynec. & Obst.* 74: 1106-1111, June 1942.

Forty-six uteri removed at operation were examined in routine fashion for the presence of carcinoma. In every instance a diagnosis of carcinoma of the fundus had been made by histologic examination of uterine curettings, and intrauterine radon treatment had been given. The interval between irradiation and operation varied from six weeks to two years. The radon dosage varied between 1,700 and 4,500 mc. hr., most cases receiving 3,000-4,000 mc. hr. Three patients had received roentgen therapy in addition, because of an earlier diagnosis of carcinoma of the cervix.

Of the 46 uteri, only 5, or 11 per cent, were free of histological evidence of tumor. Nearly all cases showed radiation reaction regardless of the state of the residual tumor.

The authors survey the literature and conclude that mortality figures from recent publications indicate some doubt as to the wisdom of giving preoperative radiation chiefly by intrauterine radium. Good results have been reported from combined operation and postoperative roentgen irradiation. One must balance the possibility of destroying the tumor or decreasing its chance of implantation against the delay and inconvenience to the patient.

[The radium dosage in these cases was obviously too low by accepted radiological standards. At least 7,000 mc. hr. are regarded as necessary for cancericidal action in most cases—I. J. M.] IVAN J. MILLER, M.D.

End-Results in the Treatment of Carcinoma of the Cervix; A Fifteen-Year Report, 1921-1936. L. C. Scheffey, W. J. Thudium, and D. M. Farrell. *Am. J. Obst. & Gynec.* 43: 941-952, June 1942.

The authors bring up to date the account of their experience in the treatment of carcinoma of the cervix, adding 131 cases to those previously treated, making a total of 277 treated cases with a follow-up of 97.2 per cent. (For the earlier reports see *Am. J. Obst. & Gynec.* 22:247, 1931; 31: 946, 1936.) The classification of carcinoma is that used by Schmitz. The vast majority of the patients treated (238) exhibited advanced lesions (groups 3 and 4). In the authors' experience patients seen with relatively early lesions are rare. The youngest patient was a 22-month-old infant; the youngest adult was 22 years old, and the oldest patient 84; 80.2 per cent of the patients were between thirty and sixty, with fairly even distribution in the age groups.

Of the 277 patients treated 38, or 13.7 per cent, were

alive at the time of the report, from five to twenty years after treatment. The absolute salvage rate (the authors prefer not to use the word "cure"), based on 293 patients observed, was 12.9 per cent. In addition to the 38 living patients, 26, either dead or untraced, had survived from five to fifteen years, bringing the total relative five-year salvage figure to 23.1 per cent. The authors express the opinion that older patients have done twice as well as younger ones, as regards survival.

Treatment included surgery in only 8 cases, but no patient was treated solely by this means. The opinion is expressed that surgery is inadequate alone and that, if a surgical decision is made, it must be based on the premise of an undoubtedly early lesion, and carried out by one qualified to perform a truly radical operation.

The technic of irradiation is described as a matter of record, though it is not that at present used. From 1921 to 1931 treatment was chiefly by radium, occasionally supplemented by roentgen irradiation. In the ensuing years roentgen therapy was used in an increasing number of cases, and more recently preliminary roentgen therapy has become routine. During the period under consideration, 1921-36, there was considerable variation in radium dosage. The highest average was 4,300 mg.-hr. in 1927-28, but this was reduced to 3,600 mg.-hr. in 1928-36. Prior to 1927 x-ray treatments were with 170 kv.p. radiation filtered with 0.5 mm. of copper and 1.0 mm. aluminum, at 50 cm. skin-target distance, single massive doses being delivered to each of three or four pelvic ports. The total dosage to each port varied from 800 r to 2,100 r. After 1927 the fractional method was followed, with 4 ports, 2 anteriorly and 2 posteriorly with an objective of 100 per cent of the skin erythema dose into the depths of the pelvis in two weeks. The total dosage delivered to each port by this method varied from 1,400 to 1,500 roentgens. The authors express the opinion that x-ray diminishes local necrosis, slough and infection, pain and bleeding. At the present time radium application is delayed from two to three weeks to avoid severe reaction from combined external irradiation and radium.

The authors do not regard histologic grading as a practical guide to prognosis. Radiosensitivity is relative and radiocurability is not an equivalent term. The majority of their surviving patients exhibited lesions of a low or intermediate grade of malignancy and patients with anaplastic highly malignant tumor cells reacted badly to irradiation. Their study of 20 years is said to be discouraging but their successes "keep alive that spark of effort" which induced them to go on and on, constantly trying to improve their methods. It is of particular interest that 97.8 per cent of the cases were followed.

PAUL R. WEEKS, M.D.

Radiation Injuries of the Intestines and Urinary Bladder in the Radium Treatment of Cancer of the Uterine Cervix. J. J. Chydenius. *Acta radiol.* 23: 1-8, February 1942.

While the radiotherapeutic results in the treatment of cancer of the cervix have steadily improved during the past two decades, we still have to cope with the problem of radiation damage to the adjoining tissues and organs, especially the rectum and bladder. The relation and distance between the uterus and these organs can vary considerably; the consequence is that the incidental radiation effect (and damage) may also vary, accordingly. The method of measuring dosages in mg.-hr. is unsatisfactory, and the author recommends the

use of the isodose curves calculated in r which he worked out in previous publications. The least injurious radium dose observed by him is 2,400 mg.-hr. in the vagina and 1,800 mg.-hr. in the uterus. According to Chydenius, it is advisable to keep the radium dosage within definite limits or even to decrease it. At the same time, the technic of the supplementary roentgen radiation should be further developed in order to enable more effective parametrial treatment with minimal damage to rectum and urinary bladder.

E. A. SCHMIDT, M.D.

Malignancy of the Vulva. S. C. Graves and J. Mezer. *Am. J. Obst. & Gynec.* 43: 1016-1021, June 1942.

Sixty-six cases of cancer of the vulva were seen at the Free Hospital for Women (Brookline, Mass.) between January 1890 and January 1941. Thirty-nine cases arose from the labia. In 9 cases the cancer was located about the urethra; in 10 the clitoris was involved, and in 4 Bartholin's glands.

Most of the patients complained of a "lump" or an "ulcer" in the vulvar region. Bleeding occurred in 18 of the cases. Four cases were seen in less than one month from the time of onset, but on the whole the patients presented themselves long after the appearance of symptoms—from six months up to two years. The series includes, besides carcinoma, 1 fibrosarcoma, 1 hemangiosarcoma, and 1 lymphoblastoma of the vulva. Associated leukoplakia or kraurosis was found in 54.5 per cent of the cases.

End results are presented for 54 cases seen prior to January 1937, showing a five-year salvage of 15 or 27.7 per cent. Partial vulvectomy or local excision was performed 11 times, 4 times in conjunction with radium therapy. Two of this group lived five years. Complete vulvectomy was performed 14 times, with 5 "cures." Nine patients had complete vulvectomies followed by bilateral groin dissection and of these 5 (55.6 per cent) lived for five years. Five patients in this group had groin metastases and of these 1 survived for five years. Of the patients without node metastases, 3 (75 per cent) were known to be living and a fourth was thought by relatives to be alive but could not be traced.

The authors advocate wide vulvectomy plus a bilateral groin resection (i.e., the Bassett operation) if the disease is not too advanced or the patients are not in too poor condition. The operative mortality for 55 patients subjected to surgery in one form or another was 5.4 per cent. Experience with radiation was not encouraging and in the authors' opinion this should be used only as a last resort. Twenty-one of the cases were treated with radium, but dosage factors are not tabulated and the total dosage is reported to have varied between 200 and 4,800 mg.-hr. The time interval and regions of application are not specified. In 5 cases radium was directed to the groin for metastatic disease. X-radiation was used in 18 cases, but technical factors of its administration are not given except that of dosage variation between 800 and 3,200 r with approximately 1,600 r as the usual dose.

PAUL R. WEEKS, M.D.

Hodgkin's Disease: Five Year Survival Rate; Value of Early Surgical Treatment; Notes on Four Cases of Long Duration. D. P. Slaughter and L. F. Craver. *Am. J. Roentgenol.* 47: 596-606, April 1942.

The authors review 265 cases of histopathologically proved Hodgkin's disease treated at Memorial Hospi-

tal (New York) from 1918 through 1935. Statistical analysis of this group shows a general broad agreement with published reviews of other large series. The average survival period for all cases from the time of beginning of therapy was 33.8 months, and the average survival time for the 211 patients who had died was 24.6 months. Of all patients followed, 17.7 per cent survived five years and 3.4 per cent more than ten years following institution of treatment. In this series 62 per cent of the patients were males and 38 per cent females. The extremes of age were five and seventy-six years.

The most common site of initial involvement seen in the series was the lymph nodes of the left side of the neck. No correlation could be demonstrated between the histopathological picture of a given case and the subsequent course. The prognosis appeared to depend more on the location and extent of involvement. When several lymph node groups are involved, palliative irradiation is used, consisting of a total of 600 to 1,200 r to each involved area for the series. Where there is demonstrable involvement of only one lymph node group, "obliterative" irradiation is used, consisting of fairly large single doses, the total dosage being much higher than required for immediate regression of the lymph node masses. The authors suggest that in cases of localized involvement the best results may be obtained by surgical excision of the involved nodes followed by roentgen therapy.

Four cases are reported in detail because of their long survival periods, ranging from sixteen and one-half to possibly thirty-three years. H. H. WRIGHT, M.D.

Pregnancy Complicated by Hodgkin's Disease. A. H. Klawans. *Am. J. Obst. & Gynec.* 43: 895-896, May 1942.

The author presents a brief preliminary report of a case of Hodgkin's disease which had its onset during the second trimester of pregnancy. The patient was aged thirty-three years and was first seen when three months pregnant. Her past history was negative except for a long history of eczema of the entire body with itching. The physical examination was negative. After another three months the patient complained of a swelling in the right inguinal region and a chain of enlarged nodes, each about the size of a hazelnut, was found. No other adenopathy was discovered. The nodes doubled in size in two weeks and biopsy was performed with a subsequent diagnosis of early Hodgkin's lymphogranulomatosis. A cough developed, but a roentgenogram of the chest was negative. Pregnancy seemed to be developing normally. The condition grew worse; the right inguinal nodes continued to enlarge, attaining a size of two fists, and extensive edema of the vulva developed. Induction of labor was deemed inadvisable and, since emptying of the uterus was believed imperative, a cesarean section was performed and a normal female infant, weighing 6 pounds 14 ounces, was delivered a little more than one month after the biopsy. The vulvar edema rapidly subsided and massive roentgen therapy was begun, but the patient's condition became worse with death forty-five days after delivery.

PAUL R. WEEKS, M.D.

Case of Mycosis Fungoides Metastasizing as Polymorphous-Cell Sarcoma. H. Hemmingson. *Acta radiol.* 22: 606-619, December 1941.

The etiology of mycosis fungoides is still unsettled. Gillot considered it a leukemic or pseudoleukemic entity

(lymphadénie cutanée), while Kaposi classified it as sarcomatosis of the skin. Most authors now consider it a granuloma of infectious or toxic origin, representing—though largely localized in the skin—a systemic disease. It is rarely seen before the fourth decade of life and affects men more often than women. Radiation may afford temporary relief of the skin symptoms but cannot prevent the final fatal outcome.

Hemmingson describes the case of a 58-year-old business man who, from 1935 to 1941, suffered from mycosis fungoides. From 1937 to 1940, he received, in addition to intramuscular arsol injections, fractionated x-ray treatments over a total of 81 skin areas, the individual treatments varying from 100 to 200 r. These relatively small doses were, at least in the beginning, sufficient to relieve itching and to cure the skin manifestations. On admission to the Radiumhemmet in 1940, the patient presented large ulcerating infiltrations and tumors on the trunk, extremities, and face. The face tumors received about 2,400 r (in doses of 200 to 250 r), while the trunk infiltrates received 700 to 1,000 r. All these infiltrates, as well as the skin manifestations, receded before death. Metastases in the groin were treated with 800 to 2,000 r, and nodes in the axilla received 500 r, but the treatment had to be discontinued on account of progressive cachexia. The metastases in the subcutis, the lymph nodes, and internal organs presented the cell structure of polymorphous sarcoma. E. A. SCHMIDT, M.D.

BENIGN CONDITIONS

Radium in the Treatment of Uterine Bleeding Caused by Benign Lesions. L. M. Randall, S. B. Lovelady, and F. S. Sluder. *Am. J. Obst. & Gynec.* 43: 377-387, March 1942.

Radiation treatment of 196 women from 1930 to 1935, because of atypical uterine bleeding, is reviewed. The cases are classified according to age groups and the type of radiation treatment employed. In all cases the treatment was preceded by dilatation and curettage and microscopic examination of the endometrium removed.

Details as to the filtration, milligrams of radium, the type of applicators and exact regions of application are not given. The dosage used is grouped as less than 500 mg.-hr., 500 to 1,000 mg.-hr., 1,000 to 1,200 mg.-hr. or more. Roentgen therapy was used in 21 cases. Exact information as to the dosage is not given, although total dosage varying from 525 to 1,760 roentgens is mentioned. The number of fields varied per patient.

A satisfactory control of bleeding was obtained in 75 per cent of the cases treated. Hysterectomy was done in 17.7 per cent of the 196 cases because of persistent bleeding. In the opinion of the authors the percentage of good results from all types of radium treatment increased with the age of the patient. The estimated good results are 50 per cent in the age group 27 to 35 years, 62.7 per cent of those from 35 to 40 years of age, and 91 per cent of those more than 40 years of age. As the age of the patient increased, there was a tendency to increase the dose of radium. In the age group between 30 and 40 the choice of treatment is difficult because of the desirability of retaining ovarian function. Radiation therapy does not preclude the subsequent performance of hysterectomy.

The authors express the opinion that radium or roentgen rays may be used in preference to surgical

treatment for women in the fifth decade of life suffering from atypical uterine bleeding caused by benign lesions, when the natural menopause is to be anticipated shortly, when the uterus is no larger than it is in the third month of pregnancy, when the operative risk is increased because of associated conditions, and when no gross evidence of active pelvic inflammatory disease exists.

PAUL R. WEEKS, M.D.

Treatment of Sterility with "Small Dose" X-Ray Therapy. M. Friedman and R. Finkler. *Am. J. Obst. & Gynec.* 43: 852-857, May 1942.

A patient, aged 26, with a history of menstrual irregularity and sterility of six years' duration experienced three pregnancies subsequent to "small dose" x-ray therapy. The first x-ray treatments were preceded by comprehensive endocrine studies in which endometrial biopsies showed an incomplete or abortive luteinization process. Four x-ray treatments were given from June 25 to July 5, 1936, delivering a total dose of 80 r (measured with back scattering) to the pituitary gland and 80 r to each ovary. The half value layer and the size of the fields treated are not given. The patient menstruated regularly one month later and conceived after the third regular menstrual period, at which time an embryo with an estimated age of 11 to 12 days was removed incident to an endometrial biopsy. Regular menstruation followed the accidental abortion. A second pregnancy occurred nine months after the "small dose" x-ray therapy and the patient was delivered of a full-term normal female child. Menstrual bleeding returned four months after delivery (in December 1937) and was regular, with the exception of one missed period, until November 1938, when an amenorrhea lasting eight months ensued. A second series of "small dose" x-ray therapy was given and this series was followed by normal periods and pregnancy in the fourth month after the treatments. Subsequently the patient was delivered of a normal male child. The authors' experience, as well as that of Kaplan (*Am. J. Roentgenol.* 42: 731, 1939) and of Mazer and Baer (*Am. J. Obst. & Gynec.* 37: 1015, 1939), who analyzed 32 articles on the subject as well as describing their own extensive experiences, causes them to express surprise that this type of therapy is not oftener attempted.

In discussing the findings of this case, the term "x-ray stimulation" has been discarded in favor of the non-committal "small dose x-ray therapy." The authors believe it possible that this type of therapy can destroy some inhibitory factor. They call attention to evidence concerning possible damage to the unfertilized ovum with resultant injury to the offspring based chiefly on the effect of x-rays on the fruit fly (*Drosophila melanogaster*), and to a lesser extent the mouse and guinea-pig. "The frequency with which difficulties are encountered in attempting to transpose the results of animal experiments to human beings is well known." In the authors' opinion the statistical probability of a previously irradiated ovum ever resulting in a monostrousity following fertilization is so small as not to constitute hazard. They believe the possible theoretical dangers should be explained to the patient and the final decision left to her. PAUL R. WEEKS, M.D.

Chondrodermatitis Nodularis Chronica Auriculæ. B. Ebenius. *Acta radiol.* 22: 563-572, December 1941.
Chronic nodular chondrodermatitis of the external ear

is, according to the author, not a rare disease, although references to it are not frequent in the medical literature. Cases in the United States were described by Foerster of Milwaukee in 1918 and 1925 as "painful nodular growth of the ear." In the Stockholm Radiumhemmet, 33 microscopically verified cases were treated from 1923 to June 1941. Many of the earlier cases were classified as "hyperkeratosis," "chronic ulcer," or "questionable cancer."

As a rule the clinical manifestations consist in a solitary, painful, round, or oval node (rarely, several nodules) which generally does not exceed 5 mm. in diameter. Frequently the apex of this node is ulcerated and shows a small fistular canal with scanty secretion or suppuration.

The site of predilection is the upper anterior margin of the auricular helix. Histologically the epithelial changes can be identified as hyperplasia, hyperkeratosis, and, sporadically, parakeratosis. Most authors assume that this form of chronic nodular chondrodermatitis never undergoes malignant change, but Ebenius is not convinced of the truth of this assumption. The sub-epithelial connective tissue shows plasmolymphocytic cell infiltration, in many cases with fibrinoid degeneration and edema or even necrosis of the connective tissue. Similar changes are noticed in the perichondrium. The cartilage shows regressive changes with indistinct limitation, edema and, finally, necrotic decay. In the differential diagnosis, cancer, inverted papilloma, atheroma, senile hyperkeratosis, lupus erythematosus, tuberculosis verrucosa, papulonecrotic tuberculids, tophi, and darwinian tubercle are to be excluded.

The etiology is not definitely established. A certain diathesis in connection with circulatory disturbances and slight traumatism is probably the essential causative factor.

Therapeutically, the author prefers surgical extirpation or other methods (radiotherapy, carbon dioxide snow, or electrocoagulation). The danger of recurrence exists but can be reduced by removal of a relatively large area of the underlying cartilage.

E. A. SCHMIDT, M.D.

Gestation Fourteen Years after Radium Induced Amenorrhea. M. Rosenberg and S. B. Schenck. *Am. J. Obst. & Gynec.* 43: 1033-1036, June 1942.

A case is reported because of the rarity of gestation after so prolonged a period of amenorrhea—fourteen years—following intrauterine application of radium. The patient was a white woman 47 years of age, who had received 1,200 mg.-hr. of intrauterine radium fourteen years earlier, for menorrhagia and metrorrhagia. She was seen complaining of profuse vaginal bleeding and because of this and the presence of a pelvic mass a diagnosis of submucous fibroid was made and hysterectomy was performed. The uterus measured 11 × 7 × 4 cm. and was occupied by purple red tissue, clotted blood, and a glistening red membrane. Microscopic examination showed chorionic villi, syncytial buds, and islands of decidual cells. The ovaries showed evidence of follicular activity and recent corpora lutea, and, although no menstruation had occurred, cyclic ovarian function is shown to have existed. The authors assume that the ovaries had regenerated and become susceptible to stimulation of the pituitary gonadotropes.

PAUL R. WEEKS, M.D.

Roentgen Treatment of Lumbago. A. Clausen. *Acta radiol.*, 23: 67-78, February 1942.

In the five-year period from 1935 to 1939, Clausen treated 394 lumbago patients with roentgen radiation. Upon 330 of this number (237 men and 93 women) who were followed up either by examination or by report, this study is based. The author regards as "lumbago" all cases of acute or chronic back pain without a definite etiologic background. This means that cases of tumor, tuberculous spondylitis, polyarthritides, Bechterew's disease, and gynecologic affections are excluded. A few cases of moderate spondylolisthesis are included on the assumption that the pain in these cases is, as a rule, not caused by the spondylolisthesis proper but by muscular and ligamentous changes in the neighborhood.

The results in the acute cases were especially striking. After three applications of 150 r to a lumbar field (at two- or three-day intervals) 98 per cent of patients became practically free of symptoms. Of the chronic cases, 85 per cent showed improvement, which amounted to practical freedom from symptoms in 65 per cent. Only after the age of seventy years, the results were somewhat less marked. The author hopes that these results may be improved still further if recourse is taken to continued treatments.

E. A. SCHMIDT, M.D.

TECHNIC

Some Experimental and Clinical Lights on Rotation Therapy, Its Basis and Possibilities. J. Neilsen and S. H. Jensen. *Acta radiol.* 23: 51-66, February 1942.

This article is of interest in relation to the renewed attention devoted in the past few years to improvement of the therapeutic depth dose by means of rotary irradiation. The authors record their experimental work, as well as their results in cancer of the esophagus treated by this method.

Rotation irradiation, in its simplest form, consists in rotating the patient about an axis passing through the center of the tumor at right angles to the beam, or in a corresponding movement of the tube about the patient whose position remains unchanged. Essentially, it is the irradiation, in succession, of many small fields, the central beam, of course, being directed through the center of the tumor.

The experimental work on a thorax phantom and an anatomical preparation was confined chiefly to the measurement of the depth dose, with the use of small ports (less than 50 sq. cm.), 180 kv., 6 ma., 50 cm. target-skin distance, and a variety of filters (Thoraeus, 0.5 mm. Cu, 3 mm. Al) or no filter at all. Many graphs

and isodose charts were produced which showed that, when small ports are used, the ray quality has very little to do with increasing the depth dose, since, with the weakest filter (no filter; HVL Cu 0.32 mm.) relatively as good a depth dose was obtained as with the stronger ones. The ratio of the skin dose to the depth dose was about 1:3, depending on the size of the port but very little on the filtration.

A unique method was employed in the treatment of 8 cases of cancer of the esophagus. The patient was seated on a motor-driven, rotating seat in such a manner that the esophagus lay in the axis of the stool's rotation. The size of the skin field, usually 4×6 to 6×12 cm., was controlled by a lead diaphragm placed between the patient and the target. The centering of the esophagus was facilitated by having the patient swallow bismuth paste and visualizing the lesion on a fluoroscopic screen placed between the patient and operator. If the esophagus fell outside of the beam during the rotation, the centering could be re-established by moving the lead diaphragm.

The air dose used was large, compared to the conventional, multiple port, stationary method. A daily dose of $2 \times 1,000$ r (2 complete rotations) for a total of 20,000 r was given over a period of three weeks without any ill effects, local or general. In all 8 cases treated thus far, subsequent roentgen examinations have shown a marked regression of the tumor.

It may well be concluded from the experimental work on the thorax phantom that other tumors, though eccentrically situated, can be advantageously treated by the rotary method; for example, tumors of the hypophysis, cancer of the rectum, and some cancers of the cervix with parametric infiltration.

GLENWOOD L. COOK, M.D.

A Light-Weight Compressing Tube-Diaphragm for Roentgen Therapy. R. Thoraeus. *Acta radiol.* 22: 848-852, December 1941.

A newly designed "compressing tube-diaphragm" is described which, from a practical standpoint, is essentially the same as those used in most American therapy departments, except for the weight. The base-plate is made of 2-mm. brass lined with 2-mm. lead, both joined by soldering. The tube is made of aluminum plate 1.5 mm. thick lined with 0.5-mm. lead. The bottom is 3 mm. thick and is made of plywood. The tube-diaphragm is mounted directly to the head without the use of a master cone. The average weights for 50 cm. focal-skin-distance vary between 1.5 and 2.7 kg., depending on the surface field.

GLENWOOD L. COOK, M.D.

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